AN EVALUATION OF THE CHRISTCHURCH HOSPITAL'S OCCUPATIONAL THERAPY PROGRAMME FOR CHILDREN WITH PERCEPTUAL-MOTOR DEFICITS

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A thesis submitted in partial

fulfilment of the requirement for the Degree of

Master of Arts in Psychology and Education

University of Canterbury

1985

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ACKNOWLEDGEMENTS

I would like to thank the three paediatric occupational therapists at Christchurch Hospital, Mrs. Marie Chester, Mrs. Sally Wilson, Ms Elizabeth Saunders, their secretarial assistant, Ms Gillian O'Brien, and the physical education teacher, Mrs. Helen Leahy, for their co-operation, support and assistance with this study.

I would like to gratefully acknowledge the McKenzie Foundation for their financial assistance without which this project would not have been possible. My thanks are also extended to the members of Contact Organisation, who provided much important practical assistance, to the teachers, parents and children involved in this study for their co-operation, and to my typist, Mrs. Glenys Lamb, for her help.

Finally, I would like to thank Professor Graham Nuthall, whose understanding has been central to the learning experience which this project has been for me.

ABSTRACT

This study evaluated the Christchurch Hospital's Occupational Therapy programme for children with perceptual-motor delay. A review of previous studies which evaluated sensory integrative therapy found conflicting results. It was suggested that this was because the studies used different types of subjects, treatment programmes and measures. The studies also provided no consistent guidelines on which children are best suited to treatment with sensory integrative therapy.

Fifty-five children were assessed on measures of perceptual-motor development, language development, self-concept and reading development. Teachers and parents completed questionnaires to record their perceptions of the children's progress. The children were randomly assigned to either the occupational therapy treatment, a physical education programme or a no treatment control group.

Three approaches were used to analyse the effect of treatment group on children's progress. Comparisons between groups indicated that the occupational therapy programme produced significantly better performance than the physical education programme in both reading and fine motor skills, and significantly better performance than no treatment in reading, but not fine motor skills.

It was concluded that the occupational therapy programme was significantly related to children's improvement in reading, but that the effect of the programme on fine motor skills was unclear. The occupational therapy programme did

not appear to affect children's language, gross motor or visual motor development on the measures used in this study. It was also concluded that some children progressed more than others as a result of the occupational therapy treatment and that the children who progressed most were those who were clumsy but did not have other handicapping conditions such as behaviour problems, neurological impairment or general delay as a result of socio-cultural deprivation. It was suggested that studies which examine the factors that influence children's progress in therapy, rather than comparative evaluation studies, are needed in the area of research on sensory integrative therapy.

CHAPTER 1

LITERATURE REVIEW

1.0 INTRODUCTION

Sensory integrative therapy (Ayres, 1972) is becoming increasingly controversial as a treatment of learning disabilities (Goodman and Hammill, 1973; Sieben, 1977). Its proponents (e.g. McCormick, Schnobrich, Footlik and Poetker, 1967; Price, 1977) suggest the allocation of resources so that the therapy can become a permanent part of the regular school curriculum. Its critics, however, argue that there is no convincing proof of the treatment being beneficial, and that its application is therefore irresponsible (Bochner, 1980; Lerer, 1981). This mirrors the heated debate following the publication of the Doman-Delacato (1960) theory and treatment procedures (Hallahan and Cruickshank, 1973). In this study the relationship of sensory integrative therapy to learning disabilities and perceptual-motor delay is examined.

This review is divided into three parts. The first section is an introductory section. It includes a summary of the definition, incidence and treatment of learning disabilities. This is followed by a description of sensory integrative therapy (SIT) and an examination of SIT's theoretical foundations. The different approaches of Kephart (1960), Getman (1968), Frostig (1967), Barsh (1967), Cratty

(1969) and Doman and Delacato (1960) are compared in this section.

In the second section, evidence of the effectiveness of these perceptual-motor programmes is reported and reviews and recent studies of the effectiveness of SIT (Ayres, 1972) are examined. Studies on the effectiveness of Doman and Delacato (1960) procedures are not included in this review, because of the lack of comparability between these procedures and SIT.

In the final section factors which may account for the diverse outcomes of SIT research, are discussed.

1.1 INTRODUCTION TO LEARNING DISABILITIES AND NEUROLOGICAL PROCESS THEORIES

1.1.1 Learning Disabilities

Definition

The concept of specific learning disabilities is, itself, controversial at each of the three levels of definition, assessment and treatment (Larsen, 1976). It is an omnibus term and refers to a heterogeneous group of children (Hallahan and Cruickshank, 1973). Definitions, generally, but not always, include the concept of difficulties in school learning beyond that which would be predicted from intelligence, or uneven performance across a variety of tasks, and exclude children whose primary problems are mental retardation, sensory handicaps, educational or cultural deprivation, or severe emotional disturbance (Chalfant and King, 1976; Hallahan and Kauffman, 1976; Myers and Hammill, 1976). There are, however, a number of difficulties with the use of this definition. In practice, the identification of learning

disabled children is an imprecise, somewhat subjective task (Bochner, 1980; Chalfant and King, 1976; Myers and Hammill, 1976) and there is, for example, some suggestion that the label of learning disability, which for many is preferable to that of mental retardation, is more likely to be given to children from middle class, than lower class homes (Kealy and McLeod, 1976). Given these difficulties, it has been suggested that learning disabled children are identified according to specific syndromes on the basis of clinical criteria (Myers and Hammill, 1976), a practice that the Diagnostic and Statistics Manual of Mental Disorders (Third Edition) follows.

Terms that have at various times been used synonymously with specific learning disability include minimal brain disorder, dyslexia, perceptual handicap, minimal cerebral dysfunction, and developmental aphasia (Myers and Hammill, 1976).

Sensory integrative therapy is also directed at "clumsy children" or children with perceptual-motor delay. While the exact relationship between clumsy children and children with learning disabilities has not been clearly established, some theorists propose that most, if not all, learning disabled children manifest perceptual-motor dysfunction (Vellutino, Steger, Moyer, Harding and Niles, 1977).

Incidence

The actual percentage of the school age population with a learning disability is disputed, which is not surprising, given the disagreement on definition. Estimates range from 5% to 40% (Goldstein, O'Brien, and Katz, 1981). The actual figure probably lies between 10 and 20% (Myers and Hammill,

1976; Tarnopol, 1971). A recent New Zealand survey of children with perceptual-motor dysfunction found 18.6% of the primary school population scored in the lowest three stanines on tests of fine and gross motor skills, and can be considered to evidence significantly impaired motor skill development (Donaldson and Maurice, 1984).

Remediation of learning disabilities

There are two general approaches to remediating learning disabilities; the academic approach (Larsen, 1976; Vellutino, et al, 1977), which follows an educational model and involves direct instruction of specific skill deficits, and the neuropsychological process approach which follows a medical model, and involves activities designed to remediate the perceptual and motor deficits considered to underlie the learning problems (Ayres, 1972a; Barsch, 1967; Delacato, 1966; Getman, 1968; Kephart, 1960; Kirk, 1968). It is not uncommon for children to receive concurrently, treatment based on both approaches (Larsen, 1976). The neuropsychological process approach can, in turn, be divided into two distinct theoretical subgroups. These are the perceptual-motor theories (Ayres, 1972a, Barsch, 1967; Frostig, 1967; Getman, 1968; Kephart, 1960), and neurological organization theory (Doman, Spitz, Zucman, Delacato and Doman, 1960).

1.1.2 Neurological Process Theories

Sensory Integrative Therapy

SIT (Ayres, 1972a) belongs to the neuropsychological process theories. It is a form of perceptual-motor training designed for children with learning problems, who exhibit

poor sensory motor development and is normally implemented by occupational therapists. Therapy aims at modifying the neurological dysfunction interfering with learning, rather than attacking the symptoms of that dysfunction. The term sensory integration itself refers to the ability to organize information for use (Ayres, 1972a).

According to Ayres's (1972a) theory, handeye co-ordination, visual and spatial perception, speech, and concentration necessary for school learning are based on such abilities as the ability to co-ordinate two sides of the body, to plan motor activities and to perceive the body's position in space. These develop from the adequate perception and integration of auditory, vestibular, proprioceptive, tactile and visual stimuli.

Remediation based on the sensory integration model typically involves administration of the Southern California Sensory Integration Tests (SCSIT) (Ayres, 1972c) and the Southern California Post-Rotary Nystagmus Test (SCPNT) (Ayres, 1975). The SCPNT measures the duration of nystagmus (involuntary oscillations of the eye) following rotation. This is intended to reflect the adequacy of vestibular functioning. Patterns of deficits evident in these tests, along with clinical observations of related behaviours (such as postural insecurity) are examined to determine the congruence with deficit patterns for various syndromes, including postural and bilateral integration, apraxia (motor planning), auditory language problems, disorders in form and space perception, tactile defensiveness (hypersensitivity to touch sensations) and unilateral disregard (Ayres, 1972a). Individual remedial programmes are then

designed. Suggested activities for a child with a disorder in postural and bilateral integration, for example, may include riding a scooter-board down a ramp in prone position, or rolling up in a rug or large cloth.

Other Perceptual Motor Theories

The Kephart (1960) and Getman (1968) approaches are similar in many respects (Goodman and Hammill, 1973) and will be examined together in this review. Kephart (1960) divides his programme into four separate areas, which include chalk-board training, sensory motor training, training in ocular control and training in form perception. Getman (1968) proposes six developmental training areas. These are: general co-ordination, practice in balance, practice in eye-hand co-ordination, practice in eye movements, practice in form perception and practice in visual memory. Both programmes focus on the development of both motor and visual skills in a hierarchical sequence. Differences in the two approaches include a greater emphasis on visual rather than motor development, and greater structure and more language activities in the Getman (1968) approach (Goodman and Hammill, 1973; Hallahan and Cruickshank, 1973).

The perceptual-motor test and programme designed by Frostig (1967), like the Getman (1968) programme, emphasizes visual perceptual skills more than motor skills. The Frostig test is comprised of five sub-tests, each of which is intended to measure a discrete area of visual perception. These abilities are: eye-motor co-ordination, visual figure ground discrimination, form constancy, position in space and spatial relations (Frostig, 1967). The major components of

the programme follow the five sub-tests of Frostig's diagnostic test, and the specifically recommended training activities are quite similar to items contained in the test (Hallahan and Cruickshank, 1973).

Of the theorists thus far discussed Barsch (1967) has designed the most motor-oriented programme for remediating learning disabilities. Barsch (1967) postulated a theory of Movigenics and proposed twelve components for the Movigenics curricula, which include muscular strength, dynamic balance, spatial awareness, body awareness, visual dynamics, auditory dynamics, kinesthesia, tactual dynamics, bilaterality, rhythm, flexibility and motor planning.

Cratty (1969) also has formulated a programme concerned predominantly with motor learning. He justified the use of perceptual-motor training by its effect on motor skills without reference to effects on academic performance. He thus stands apart from the other perceptual motor theorists, (Myers and Hammill, 1976).

These five perceptual-motor theories clearly share a number of assumptions about the basis of learning disabilities. They are differentiated from one another, however, by several characteristics. These include their relative emphasis on visual or motor development and the importance placed on etiology and CNS involvement. SIT is placed toward the motor end of the visual motor continuum and is more concerned with neurological foundations, whereas the other perceptual-motor theories focus more on the construction of educational programmes based on the behavioural characteristics of the children.

Doman and Delacato Approach

The Doman and Delacato (1960) theory and treatment procedures, have less in common with SIT (Ayres, 1972) than with the other perceptual-motor approaches. They do, however, share a number of similar assumptions. The theory asserts that, if, for any reason the neurological development of a child does not proceed through certain stages, the child will have difficulties in mobility, speech and reading (Delacato, 1966). The diagnostic procedure consists of finding the stage at which impairments of proper neurological growth took place by analyzing a developmental profile. The subsequent treatment programme involves externally manipulating the child into body patterns characteristic of the level of the damaged brain, and imposing hemispheric dominance and unilaterality in order to remediate damaged areas of the brain (Doman et al, 1960). Such activities as rhythmical cross-pattern creeping and visual pursuit of an object held in a child's hand may, for example, be part of the child's training programme (Glass, unpublished).

Compared to the perceptual-motor theories, the Doman-Delacato (1960) approach, focuses much more on treating assumed damage to the central nervous system and specifies to a greater extent the expected neurophysiological change. The treatment programmes of the Doman and Delacato (1960) and the perceptual-motor approaches also differ significantly. The Doman and Delacato theory of a strict one-to-one correspondence between training activities and alteration of brain structure, often leads to the recommendation of external manipulation of the child's limbs. The perceptual-motor theories on the other hand, emphasise an active role for the child in learning. As

well, the emphasis that Doman and Delacato place on single-handedness training (Delacato, 1966) is not reflected in the writings of the perceptual-motor theorists. Ayres (1972), for example, requires both sides of the body to function in a harmonious unit before engendering hand dominance. A further unique feature of Doman and Delacato's neurological organization theory compared to the other theories, is the basic tenet that "ontogony recapitulates phylogeny" (Hallahan and Cruickshank, 1973).

Assumptions of the Neurological Process Theories

SIT and the other neurological process theories are based on three underlying assumptions. These are outlined and then critically examined.

The first assumption is that learning disorders are a result of brain dysfunction. This assumption is based on the position formulated by Strauss and Werner (1942) as a result of their work with mentally retarded children. Behaviours such as hyperactivity, distractibility, poor eye-muscle control, immature co-ordination and postural reactions, spatial and perceptual deficits, and language difficulties are claimed to be evidence of brain damage (Bochner, 1980; Lerer, 1981). Ayres, (1972a) has outlined in some detail the neurological foundations of l.d. She suggests that many of the symptoms seen in the children are a result of brainstem dysfunctions, and that it is in the brainstem that sensory-integrative processes are centred.

Secondly, the neurological process theories assume, that all learning has a sensory-motor foundation and progresses in stages from basic perceptual-motor learning through the

establishment of sensory integration to higher order cognitive functions (Vellutino et al, 1977). That is, adequate conceptual development is dependent on accurate perception. This is said to be based on the work of Strauss and Werner (1942) and Piaget (1969).

A third central assumption to the neurological process theories is that perceptual-motor activities have a remediating effect on these assumed neurological impairments.

Criticisms of these Assumptions

The first assumption that learning disabilities are a result of neurological deficits, is claimed by Lerer (1981) to be compatible with biomedical research. It has, however, been criticised on several counts. Ross (1976) noted that it is a causal link that can neither be proved nor disproved, because of the difficulty in measuring neurological deficits and the highly unethical nature of performing any well-controlled study. Green, Hope, Oates, Parry and Procopis, (1982) suggest that a l.d. may be a result of emotional, physical, academic, sensory or sensory-integrative problems or simply reflect abilities at one end of the accepted normal range. There are also a large number of children who are labelled l.d., whilst evidencing only mild to moderate failure at school and no indication of brain pathology or psychological process disorders (Larsen, 1976).

Children labelled as having learning disabilities are therefore an extremely heterogeneous group. The assumption that neurological processes are the basis of all l.d. is too unidimensional, and a model which conceptualizes disabilities as an interaction between the child and the environment is more congruent with the range of children given this label.

Ayres (1971a) avoids some of these criticisms, however, by being more cautious in her position. She does not claim that all children with learning disorders have problems with sensory integration (Ayres, 1972a). Her theory and findings, however, have been over-generalized by some followers (e.g. Price, 1977).

There is also reason to doubt the second assumption (that progress in academic skills requires adequate perceptual-motor development) on both theoretical and empirical grounds. Vellutino et al (1977) make a number of valid points regarding this assumption. They note that a school age child who shows evidence of a specific learning disability, and who by definition is of average or above average intelligence, can be expected to be well beyond the sensory motor stage of cognitive development and at a stage where perceptual-motor activities are less important than conceptual activities. A greater emphasis on the acquisition of concepts and relationships to improve perceptual efficacy, rather than a heavy investment on perceptual-motor training, is therefore suggested. Vellutino et al (1977) also review the evidence which suggests that reading disabilities may often be attributable to a variety of linguistic deficits, rather than to perceptual distortions.

It is the third assumption (that perceptual-motor activity can remediate these neurological deficits) which has the least support. Although positive evidence on the effectiveness of SIT for remediating learning disabilities may be thought to strengthen the credibility of this assumption, it is impossible to establish a causal link between improved perceptual-motor ability and specific remediation of

neurological deficits. Nor, if SIT is shown to be ineffective, is this assumption necessarily disproved, since its proponents may claim that other types of treatment conditions (e.g. number of treatment sessions) might be more effective (Wong, 1979). Ayres (1972) admits that our knowledge of what influences neurological deficit is not adequate enough to provide direct guidelines for treatment. Evidence for the effectiveness of SIT therefore, has limited bearing on the validity of the assumptions underlying it.

The question, however, of the effectiveness of SIT is a vital issue for learning disabled children, their parents, occupational therapists and also for the educational and medical authorities who are forced to make decisions about appropriate treatments for these children. Regardless of the theoretical underpinnings and the reasons why, the important question remains: Is SIT effective for remediating learning disabilities?

1.2 THE EFFECTIVENESS OF PERCEPTUAL-MOTOR THERAPY

There have been a number of comprehensive reviews of the effectiveness of perceptual-motor training programmes (Goodman and Hammill, 1973; Hallahan and Cruickshank, 1973; Hammill and Wiederholt, 1973; Myers and Hammill, 1976). Following a discussion of these reviews, research on SIT will be examined.

1.2.1 Previous Reviews of Perceptual-motor Therapies

Goodman and Hammill (1973) review 42 studies which evaluated Kephart (1968) and Getman (1962) procedures for developing perceptual-motor and cognitive skills. Of these

42 studies, 16 met the criteria of adequate research methodology established by the authors. These criteria were: a minimum of 20 experimental subjects, programme duration of at least 12 weeks or 60 sessions, and an experimental-control group design (Goodman and Hammill, 1973). The studies reviewed showed little effects of training on visual-motor skills, and equivocal effects on readiness skills, intelligence, achievement and language. As Goodman and Hammill (1973) point out, the lack of significant effect of training on perceptual-motor performance suggests that any significant effects in other areas are the result of Hawthorne effects, since the theory implies improvement in the former skills as a prerequisite for improvement in the latter skills. They conclude that perceptual-motor approaches should be viewed as highly experimental, non-data-based form of intervention until such time as more evidence for their effectiveness is obtained.

Hammill and Wiederholt (1973) review 23 studies which evaluated the Frostig Developmental programme in visual perception. Almost all the studies failed to find significant effects on reading or visual perception. The effects of the programme on school readiness were less clear, but Hammill and Wiederholt (1973) noted that most of the studies had serious short-comings in design and/or execution. Also the better designed studies tended to show negative results.

Myers and Hammill (1976) located over 200 studies that examined effects of perceptual-motor training. Of these, the 81 studies which employed more than 10 experimental subjects, had an experimental/control group design, and used procedures based on the main perceptual theorists, were reviewed.

Myers and Hammill (1976) noted that the better designed studies were more likely to produce negative findings than were the poorly designed research studies. They found 23% of the comparisons made in the better designed studies indicated that training was beneficial, while 76% of the comparisons made in the poorly designed research support perceptual-motor training. Of all the studies investigating the Frostig approach, 68% indicated the approach to be ineffective, 7% provide mixed support for the programme and 25% offer support for the approach's effectiveness (Myers and Hammill, 1976). The Kephart, Barsch, Cratty and Getman programmes were considered together. Of these studies 80% failed to validate the approaches and 10% showed mixed results. Interestingly sensory-motor variables showed the least positive results (Myers and Hammill, 1976). It seems from their review, that there is a slightly higher proportion of studies supporting the Frostig approach than the other perceptual-motor programmes. The authors conclude with a cautionary statement about the use of perceptual-motor programmes.

Hallahan and Cruickshank (1973) reviewed 42 studies evaluating the efficacy of perceptual-motor training on mentally retarded, learning disabled, disadvantaged, and normal populations. They also reject the findings of a large number of studies on methodological grounds. They consider only 17% of the studies to be well designed. The authors point out that, if these research design problems are ignored, the majority of studies report perceptual-motor training to be effective. Hallahan and Cruickshank (1973) stated:

> Reading only the authors' conclusions, one would probably decide that perceptual-motor training has a significant amount of empirical support. (p.211)

Of the studies which these authors selected as being well-designed, one used Frostig procedures with mentally retarded children and four used the Kephart approach. One of the studies which evaluated the Kephart approach, had normal kindergarten children as their subjects, and three had mentally retarded children as their subjects. There were no well-designed studies involving learning disabled populations.

These studies show conflicting results. This leads the authors to conclude that the effectiveness of perceptual-motor training in general, and individual theorist's methods in particular, cannot be determined. There is also inadequate information to determine which, if any, specific populations benefit from the procedures.

1.2.2 Research on Sensory Integrative Therapy

For both perceptual-motor therapies in general, and SIT in particular, an important area which needs to be clarified is the question of who should receive therapy.

Although Ayres designed her therapy for l.d. children, relevant studies have evaluated SIT's effectiveness with varied groups including normal children and profoundly retarded adults. In other studies, subjects have been selected from a larger group of learning disabled children without specific reasons for inclusion and exclusion having been stated. In yet other studies an answer has been sought to the question of which learning disabled children benefit most from therapy.

In these studies the progress of groups of children within the already selected subject groups was compared.

Because of the importance of the question of which subjects are suited to therapy, particular attention is drawn in each of the studies discussed in the following section, to the nature of the subjects in the study, and to any conclusions of researchers about which sorts of children should receive therapy.

In this discussion the research studies on SIT are divided into those studies (10) in which the subjects can broadly be termed learning disabled and those studies (5) in which the subjects were mentally retarded children or "normal" children. Within each of these sections, those studies which meet the Myers and Hammill (1976) criteria of an experimental/control group design and 10 experimental subjects, are discussed first. Studies with adult subjects are not examined because of their lack of comparability with the present research. Generally, earlier studies are examined before more recent studies, except in cases where two similar studies are discussed together. The conclusions of other reviewers are examined at the end of this section.

Table 1 presents a summary of the studies referred to in this section.

Better Designed Studies Involving Learning Disabled Children

Ayres' 1972 Study. In her 1972 study, Ayres compared a group of 42 learning disabled children matched with control group for degree and type of sensory integrative dysfunction. Twenty-four of these children were described as having exclusively auditory language problems. Ayres selected these

Table 1 A Summary of the Studies Evaluating SIT

Researcher and Date	Population	Age	Theory Tested	Exp. / Subject[b]	Weeks of Training	Hours of Training	Comparison Programme	Dependent Variables	Results
Ayres (1972)	Learning disabled -subgroup had auditory language problems	School-age	SIT	42/84	[a]24	UTE	No	Academic	+0
Ayres (1977)	Learning disabled with choreoathetoid movements	6-10	SIT	31/54	[a]24	[a]60	No	Motor accuracy test of SCSIT	0
Ayres (1978)	Learning disabled -subgroup had hyperactive nystagmus	6-10	SIT	46/92	[a]24	[a]60	No	Academic	+ for group with hyporeactive nystagmus 0 for entire group
Bullock and Watter (1978)	Minimal brain damaged children	Pre-school and school age	Physiotherapy sensory process +	78/85	[a]24	UTE	No	Clinical observations of neurodevelopment	+
Culp, Packard and Humphry (1980)	Normal preschoolers	3-5	Sensorimotor training	8/24	4	10	Yes - group received verbal body-part identification	Body concept development	+
DePauw (1978)	Aphasics	Pre-school	SIT	11/42	[a]42	[a]47	Yes - remedial phys-ed programme	Perceptual Motor	+
Jenkins and Sells (1984)	Motor delayed - some mentally retarded	3-15	SIT and neuro-developmental therapy	15/45	15	10 and 30	No	Gross motor fine motor academic	+0 +0 0

Table 1 (Continued)

Magrun, McCue Ottenbacher & Keefe (1981)	Developmentally retarded	3-10	Effect vestibular stimulation	10/10	2 (Reversal Design)	2	No	Frequency of verbalizations +
Montgomery & Richter (1977)	Trainable mentally retarded	5-12	SIT	25/75	32	48	Yes - developmental P.E. programme (small group)	Gross motor + fine motor 0 reflex integration +
Morrison & Pothier (1972)	Mentally retarded	Pre-School	SIT and Kephart (group)	9/27	24	UTE	Yes - social reinforcement for casually selected gross-motor activities	Gross motor + fine motor 0 language + personal-social 0
Morrison & Pothier (1978)	Mentally retarded 12 bilingual background	2½-6	SIT and Kephart (group)	10/30	52	96	Yes - movement training group	Language 0 gross motor 0
Schroeder (1982)	Children with perceptual deficits	6 yrs.	SIT	5/15	16	24	Yes - perceptual skills training	auditory discrimination 0 academic +0 perceptual-motor +
White (1979)	Learning disabled	5-6	SIT	9/19	24	24	No	Reading +
Ziviani, Poulsen & O'Brien (1982)	Learning disabled boys	5-13	SIT	8/16	13	19.5	Remedial class activities	Gross motor + fine motor + academic 0

[a] These figures are estimated.

[b] This figure represents the number of experimental subjects compared to the total subject numbers.

children from a sample of 146 children who were all referred because of learning disabilities and were all receiving special academic help.

Although Ayres is not specific in her reasons for exclusion, selection was based on pretest scores. She wrote (1972a):

> Although most of the children who had been selected by the schools showed moderate deficits in identified areas of sensory integration, some of them manifested either no or minimal involvement of the type for which a system of remedial activity had been developed and was employed. In order to provide an adequate test of the method of intervention, it was necessary to select from the total sample the children for whom the treatment program was designed. (p.24)

The experimental group received SIT for 25 to 40 minutes a day five days a week for 5 - 6 months. In the two years of this study, schools and classrooms alternated between experimental and control status to control for the use of intact groups.

Ayres (1972) found that the mean gain of the experimental group with the generalised dysfunction was significantly greater than the control group, on reading and total change scores. Differences did not reach significance in spelling, arithmetic, and oral reading scores. Perceptual-motor scores, although not reported, are stated to have also varied significantly between experimental and control groups. There were greater experimental control differences in a group with auditory language problems. The greater variability in experimental scores suggests that the training may work for some subjects better than others, although the characteristics of these subjects were not identified.

The major difficulty with this study is the inadequate control of attention and expectation factors. In general,

the reporting of data in this study also tends to be too circumscribed and condensed. It is not clear in which phase the experimental children were (year one or two), who conducted the training and posttesting, how many of the children revealed their experimental or control status to the posttesters, and what the actual means of each group were, since mean gain scores only were reported.

Ayres' 1977 Report. The Ayres (1977) report is based on the same data as her 1978 study. From the 92 learning disabled children, 54 children with mild, choreoathetosis were selected (31 in the experimental group and 23 in the control group) to test whether the choreoathetosis improved with SIT. Although Ayres (1977) noted that there was a difference in motor accuracy between the two groups, this difference was not statistically significant. In the larger population of 96 (46 experimental and 50 control) subjects, she reported significantly greater motor accuracy in the experimental than the control group, for the less accurate, but not the more accurate hand. The same criticisms which apply to Ayres (1978) report of the study also apply to this 1977 report.

Ayres' 1978 Study. Ayres (1978) selected a group of 92 learning disabled children from 128. Half of these were treated with SIT for half an hour a day for the school year while the other half of the control group children remained in their normal classes. It is not clear why 36 of these l.d. children were not included in the study. Intact groups were

used, with schools alternating between treatment and control status in the two years of the study and all children were receiving special academic help. For the analysis of results the children were divided into those children with hypo-reactive nystagmus and those children with normal or hyper-reactive nystagmus. Hypo-reactive nystagmus was associated with lack of achievement for control children and favourable achievement for children receiving SIT (Ayres, 1978). However, the hypo-reactive children had higher IQ scores, which may be responsible for this difference. Ayres argues that, of the disorders giving rise to learning disabilities, hypo-reactive nystagmus is one that is least disruptive for academic learning. Therefore these children are more intelligent. Ayres (1978) does not make a direct comparison between experimental and control groups, and pre and posttest scores are not reported so that the effectiveness of SIT on the entire group of learning disabled children treated cannot be determined.

The Ayres' (1978) study suffers a further limitation. It has been found that the abnormal response to the SCPNT (which Ayres used to determine hypo-reactivity), may not differentiate between normal and l.d. children, and that the SCPNT may not be a valid measure of vestibular function, (Polatajko, 1983). The relationship between vestibular function and academic performance is therefore called into question and Polatajko has recommended that conclusions based on SCPNT results be reviewed, and that the use of the test be abandoned.

Bochner (1980) critically examined Ayres' (1978) study along with a study by White (1979). Some of Bochner's criticisms of these studies are presented below.

White's (1979) Study and Bochner's Criticisms. White (1979) identified 19 five and six-year-old children as being at risk for reading failure, having excluded those children with general mental retardation. The nine experimental children received two periods a week of individual sensory integrative therapy for six months - a total of 24 hours of therapy, whilst the control group stayed in their normal classes. The experimental group had reached a reading level that was higher than the control group at posttesting and maintained this advantage two years after the intervention. A report of this study was also made by Grimwood and Rutherford (1980).

Bochner (1980) notes that neither of these studies controls adequately for the effects of regression towards the mean, the Hawthorne effect, different teacher/pupil ratios between treatment and control group, and teacher-related variables such as commitment to the programme. The likelihood, for example, of parents' expectations being greater in the experimental group seems quite high in the White (1979) study, since the author stated:

> The first step in implementing the programme was to hold a group lecture/discussion with parents at each school to acquaint them with the aims and methods of the programme and with the therapist. (p.234)

Additionally, neither study included information on changes of perceptual-motor skills nor, according to Bochner, did they analyse and interpret their data in an "objective" fashion.

De Pauw (1978 and Logan (1982). De Pauw (1978) investigated the value of sensory motor programmes for a

group of 23 aphasic preschoolers (11 in the experimental group, 6 in one control group and 7 in the second no-treatment control group). This represents less than 60% of the original number of subjects, the rest of whom were not available for posttesting. The experimental group and the first control group received a sensory motor programme and a remedial physical-education programme respectively, for 20 minutes daily over 7 months. The children in the experimental group showed significnatly better sensory integration as measured on 6 perceptual-motor tests of the SCSIT. Change in the children's aphasia was not measured. Although an attempt was made to control for the effect of expectation and attention, which tends to invalidate the findings of other studies, there still exists methodological weaknesses in this study. The most important of these is the large mortality rate. Moreover, intact groups were used, and although groups were roughly equivalent at pretesting, this does not control for differential effects of the children's classroom teacher. Furthermore, it is assumed, since it is not noted, that the SIT was given on a one-to-one basis, whereas the remedial physical education programme was given in a group of six, with two adults assisting. It is also not clear whether the person who posttested was aware of the experimental or control group status of the subjects.

Logan (1982) investigated the effectiveness of a sensory-motor programme, compared to a regular physical education programme on the motor performance and sensory integration of 30 academically handicapped and 30 normal first grade children. The Sensory Motor Programme, however, described by Logan (1982) bears more resemblance to the

Doman et al (1960) programme than to SIT. It consisted of developmental exercises, crawling patterns and deep pressure tactile stimulation. This study is not included in following discussions of SIT research studies.

Jenkins and Sell's Study. Jenkins and Sells' (1984) study is one of the few studies which has looked beyond the simple question of SIT's effectiveness and sought to answer questions about factors important to process. They selected 45 motor-delayed children, who ranged in age from 3 to 15 years and who exhibited a wide array of handicapping conditions including mild to severe retardation, communication disorders and emotional disturbance. They randomly assigned 15 children stratified according to severity of the delay, to each of these groups. The first treatment group received 40 minutes of individual developmental therapy once a week for 15 weeks. This involved procedures drawn from SIT (Ayres, 1972a) and neurodevelopmental therapy (Bobath and Bobath, 1976). The second treatment group received the same therapy three times more frequently each week and the third group was a control group. Dependent measures included a rating scale of postural responses, measures of writing skills, communication, social and self-help skills and inappropriate behaviours. Posttesting was conducted immediately following treatment by independent therapists who were blind to the pupils' group assignments.

Jenkins and Sells (1984) found significant effects on one of the gross motor measures and marginally significant effects on the fine motor measure. No treatment effects were found on other measures and on no measures was there any

indication of a differential effect for number of hours in therapy.

Jenkins and Sells (1984) sought to predict who should receive therapy. Initially they selected 45 children out of a group of 112 on the basis of their scores on the Pediatric Screening (P.S.) instrument (Taylor, Christopher and Freshman, 1978). It is not clear, however, how the initial 112 children came to the investigators' notice. About the P.S., Jenkins and Sells (1984) stated:

> Part 1, which accounts for 30% of the total numerical value and focuses on motor performance and combines judgments about developmental level and movement quality. Part 2 considers factors other than motor function which nonetheless are presumed to affect therapy outcome. These include: age, expected response to treatment, therapy history, alternate treatment options, immediacy of need, compliance and therapy in relation to the pupils' other needs. (p.90)

Jenkins and Sells (1984) question the usefulness of the P.S. for establishing priority for therapy services on the grounds that of the 40% of remaining subjects, it did not predict which children made the greatest gains in therapy, whereas extent of motor delay did. However, to reject the P.S. as an invalid instrument for determining priorities for treatment, and to establish extent of motor delay as a valid measure, it would have been necessary to make this comparison for the entire sample of 112 children. It is likely that the variables which predict success change depending on the sample being considered. It seems that the authors reject the P.S. on the grounds that it does not predict who should be treated first, rather than on the grounds of whether it accurately determines who is in need of therapy.

A number of sources of invalidity have been well controlled for in this study. The Hawthorne effect, however,

remains a potential source of bias. The finding that treatment intensity did not effect motor improvement is a potentially important result. If, however, improvement in the children was a result of the effects of expectation and attention, it is possible to interpret the results to mean that a certain minimal level of attention is necessary for this effect, but beyond this level, attention makes no difference to outcome. Similar findings from a study which included a fourth group receiving a placebo programme, would greatly strengthen the authors' interpretation of the results.

Other Studies with Learning Disabled Children.

Bullock and Watter (1977) assessed 108 pre-school and school age children with minimum cerebal dysfunction. Of these children 78 completed the 6 months of 'physiotherapy treatment'. Seven of the children who were withdrawn by their parents were later posttested and these comprise the control group. The Physiotherapy treatment described in the study closely resembles SIT. The authors developed a rating scale to test gross motor abilities, visual responses, orientation, spatial and postural reactions and the sensory system. Their results show a decrease in the total number of abnormalities exhibited by the treatment of children, and an increase in the untreated group. Further statistical analysis of the results is not shown. Bullock and Watter (1977) concluded:

> Detailed analyses provided overwhelming evidence of the progress made by the children. (p.119)

There are clearly a number of problems in the design

of this study which mean the authors' conclusions can not be accepted. Subjects were not randomly assigned to treatment and control groups, and there is quite a high likelihood that the two groups differed on a number of important variables, for example, parental interest and involvement. The analysis of results is inadequate and the same therapist carried out testing and treatment. Furthermore, there is inadequate control for the effects of attention and expectation,and regression towards the mean.

The Ziviani et al (1982) study is one of the few that has included both motor and academic measures amongst dependent variables. All 18 subjects were selected from small learning disabled classes and were in the average intelligence range. The eight subjects in the experimental group received SIT for 13 weeks for one and a half hours a week. The matched control group participated in "classroom activities" with a remedial teacher for the same period of time. Measures of fine motor skills showed a significant improvement for the experimental group. There were, however, no significant experimental/control differences on measures of gross motor skills, reading and spelling. The authors suggest that more treatment time may have resulted in a difference in academic scores. Unfortunately neither the exact nature of the control group activities nor whether treatment or control programmes were individually or group based, is made clear by the authors. It is highly likely that the teacher who took the "classroom activities" programme lacked commitment to treatment compared to the Occupational Therapist who treated children using SIT. The authors' claim, that the Hawthorne effect did not affect results is, therefore, in some doubt.

Schroeder (1982) compared the use of SIT with a perceptual skills programme on a group of five first grade children with perceptual deficits. The perceptual skills curriculum, focused on visual motor skills and auditory motor skills more than the SIT programme. A further group received both therapies. Although numbers are too small for definitive conclusions, children who received both therapies made the most progress, whilst the pattern of responses of the children in the other two programmes showed neither to be superior.

Better Designed Studies Involving Mentally Retarded Children

Morrison and Pothier's Studies. Morrison and Pothier (1978) compare the language development of 30 retarded pre-schoolers who received either perceptual-motor therapy (Kephart, 1960; Ayres, 1972) or movement training or no systematic training beyond the pre-school training programme. Treatment was for 12 months, three times a week for 45 minutes, in groups of three to four children. No differences between the three groups were found on the three language measures and one motor measure (Morrison and Pothier, 1978).

This study was the second study, however, undertaken by Morrison and Pothier with a mentally retarded population. In their first study, Morrison and Pothier divided 27 subjects into 3 groups. One group received perceptual-motor treatment, as in their more recent study, a second group received a programme of gross-motor activities and a third group received randomly selected predominantly fine motor activities with social attention. Twenty-three of the subjects were

randomly assigned to the three groups but the other four subjects were non-randomly assigned to the treatment group. The subjects participated in the programme for 20-30 minutes daily, 5 days a week, over 6 months. In this study which was well-designed, although with a small sample size, they found the sensory motor training procedures resulted in greater gain in overall gross motor and language development but not in fine motor and perceptual-motor development, than the other two intervention programmes.

It is not clear what may account for the different outcomes of these two studies, although Morrison and Pothier (1978) suggest that the effectiveness of the comparison programme may be a crucial factor. In their later study, the general preschool training programme contained visual-perceptual training similar to that of the Frostig programme and language development training designed by a speech therapist. There are, however, several other differences in the two studies which might account for these differences. Firstly, 12 out of the 30 children in the second study were bilingual children with English as their second language. It is possible that the relationship between perceptual-motor treatment and language development is more complicated in such children. Moreover, in the first study a wider range of dependent variables were measured.

Montgomery and Richter (1977). Montgomery and Richter (1977) evaluated the effect of SIT on 23 experimental children by comparing it with the effects of a developmental physical education programme on 20 control group children, and a recreational education programme including arts and

crafts on a further 19 control children. The subjects were all mentally retarded children from two separate schools. The sensory motor group showed significantly better performance compared to the two control groups on tests of gross motor skills and total reflex integration, but not fine motor or perceptual-motor skills. The authors concluded that neuro-motor development may be enhanced more effectively by activities which facilitate improved postural responses rather than by practice of specific motor skills.

There are, however, a number of reasons why these conclusions cannot be uncritically accepted. Firstly, three out of the four therapists who undertook pre and posttesting, also gave the therapy in the study. Moreover,the second control group was an intact group from a different school, (although stratified random assignment was used for the experimental and first control group). It is also not clear whether the therapy time was equivalent between groups.

Other Studies with Mentally Retarded or Normal Children

Magrun, Ottenbacher, McCue and Keefe (1981), using a reversal design, found that the verbalisation of developmentally delayed, but not mentally retarded children, increased after vestibular stimulation. This study has a number of limitations. It is not clear whether it was some unique feature of vestibular stimulation that increased verbalisations, or whether it was simply the effect of a new sensory experience: an effect that might be mimicked in a group who, for example, spent the time horseriding.

Culp et al (1980) examined the effects of 10 hours of sensory motor training, compared to a similar number of hours

of verbal body part identification training, on the body concept development of 27 normal preschoolers, measured by human figure drawings. The group receiving sensory motor therapy (yoga, tumbling, and balance and gross motor activities) showed significantly greater improvement in body concept.

Reviewers' Conclusions on the Basis of the Research Studies

The reviewers of SIT studies have come to very different conclusions on the basis of the research.

Bochner (1980) who reviewed the Ayres (1978) and White (1979) studies concluded that learning disabled children should receive help through other "channels that have been proven effective" (p.136). She was not specific, however, on the exact nature of these channels.

Green et al (1982) also concluded their review with a cautionary note. They examined studies by Ayres (1978), Grimwood and Rutherford (1980) and Morrison and Pothier (1978), noting the negative findings of the latter study and the limitations of the first two studies. They concluded that there is insufficient evidence either to prove or disprove the usefulness of SIT for children with learning disabilities and that it is unlikely to be effective with retarded children. It seems this latter conclusion is based entirely on the findings of the Morrison and Pothier (1978) study, since other studies on the effectiveness of SIT with mentally retarded children have shown results which confuse this picture (Montgomery and Richter, 1978; Morrison and Pothier, 1972). They also stated that SIT is contraindicated in cerebal palsy but it is not clear on what findings they base this recommendation.

Ottenbacher (1980) located eight studies evaluating the effectiveness of SIT, which he considered to be methodologically acceptable. He reviewed the statistical hypothses tests in these studies using quantitative methods. The eight studies which he reviewed, involved diverse subject groups. In one study the subjects were profoundly retarded adults (Clark, Miller, Thomas, Kucherway and Azin, 1978), in other studies, at risk readers (Grimwood and Rutherford, 1980) mentally retarded and developmentally delayed children (Magrun, et al, 1981; Montgomery and Richter, 1977), children with choreoathetoid movements (Ayres, 1977), l.d. children (Ayres, 1972; 1978) and aphasic preschoolers (De Pauw, 1978).

Ottenbacher (1982) concluded, on the basis of his analysis of these eight studies, that SIT applied to the populations involved in the studies, has empirical support, but that its application to psychiatric, emotionally disturbed, physically disabled and geriatric populations is premature, since no studies on these populations, that met the criteria, were found. This latter conclusion cannot be argued with. The veracity however, of Ottenbacher's (1982) other conclusions from quantitative reviewing are highly questionable, if the methodology of the studies on which he bases his quantitative review are examined. All the studies which he reviewed have significant methodological weaknesses, and the studies are so diverse in nature that their results can not be added together to provide a simple answer.

1.3 DISCUSSION OF RESULTS

The results of the studies which evaluate SIT are no

more conclusive than the results of research studies evaluating the other perceptual-motor theories. The studies evaluating SIT show contradictory findings and, even in similar studies,or on similar measures, there appears to be no discernible pattern to the results.

There are, however, two groups of factors which may largely account for the very different outcomes found in the studies. The first of these involves differences between studies, for example, different subject selection and programme content. The second group of factors involves methodological inadequacies of studies, which may have changed the likelihood of the studies having found positive results. These methodological inadequacies are examined, and then overall conclusions on the studies evaluating SIT are made.

1.3.1 Differences between studies

The studies evaluating SIT vary considerably in subject characteristics, variables tested, measures used to quantify these variables, programme content, duration and hours of training, therapist to children ratios, and length of time intervals between treatment and posttesting. These differences are each examined in the following paragraphs.

Subjects.

Viewed together the subjects involved in SIT evaluations form an extremely heterogeneous group. In four studies subjects were mentally retarded children (Magrun et al, 1981; Montgomery and Richter, 1977; Morrison and Pothier, 1972, 1978), in one study subjects

were normal preschoolers (Culp et al, 1980), and while the subjects involved in other studies would fall under the broad rubric of learning disabilities, specific descriptions of subjects include motor delay (Jenkins and Sells, 1982) failing readers (White, 1979), cerebal palsied (Carlson, 1978) aphasic (De Pauw, 1978) and children with auditory language problems (Ayres, (1972). Subjects in some studies ranged in age from 3 to 15 years whilst in other studies children from only one age group were selected. In some studies subjects were involved in special education classes as well as SIT programmes. Studies included varying ratios of children for whom English was a second language (Logan, 1982; Morrison and Pothier, 1978) and of children who evidenced emotional disturbance or communication disorders (Ayres, 1978; Jenkins and Sells, 1984).

Such variables may be important determinants of the effectiveness of treatment. It has been suggested, for example, that SIT may be more effective for the young child whose brain is more plastic and in the process of forming neural connections (Ayres, 1972a; 1972b; Lamport, 1974). The situation is not helped by the inadequate provision of information in many studies. Frequently information is lacking on the characteristics of subjects, other handicapping conditions that they might have and how and why subjects were selected. In some studies subjects were chosen in intact classes, whilst in other studies, subjects were selected from a pool of referrals. Whichever method of subject selection is used, detailed information is required about subjects and procedures.

Subject Selection

This raises one of the most important unanswered questions about SIT, which is the issue of who, if anyone, should receive therapy.

No clear answer to this question emerges from the studies reviewed in this discussion. Although Ayres focuses on l.d. children, it is not clear exactly which children she includes in this term. From the literature, however, it is not even particularly clear whether SIT should be limited to l.d. populations since some of the research with mentally retarded populations has shown positive results. Studies suggest that SIT procedures and aims require modification for use with mentally retarded children, but again, exactly how SIT with mentally retarded children varies from SIT with l.d. children, is not evident.

It does seem, moreover, that some l.d. children benefit more than others from therapy. Ayres wrote (1978):

> Observations that some learning disabled children respond well to sensory integrative therapy and some do not, raises the question of which neural conditions predispose the learning disabled child to responsiveness and which do not. (p.31.)

Although Ayres focuses on neurological reasons for benefiting or not benefiting from therapy, the ways in which l.d. children differ from one another are numerous, and a number of these factors may affect children's ability to gain from SIT.

The lack of understanding about how these subjects variables affect therapy effectiveness and about the relationship between the subject variables and programme content, leads to the conclusion that no clear guidelines for selecting children for SIT programmes can be determined from the SIT research. It is not clear which children are suited to SIT therapy.

Dependant Variables

The difficulty of determining which dependent variables should be used to assess the perceptual-motor programmes has been noted by several authors (Hallaham and Cruickshank, 1973; Myers and Hammill, 1976), and the failure to report perceptual-motor variables has been criticised (Bochner, 1980; Myers and Hammill, 1976). The reporting of different dependent variables in different studies may account, to some extent, for the diversity of findings, since if the percentages of positive, mixed and negative results for the different areas of performance are compared, it seems that visual-motor variables have shown the most positive results, and sensory-motor and cognitive-language the most negative results (Myers and Hammill, 1976). A table showing results relative to the four areas of performance reported for studies which evaluated SIT, can be found in Appendix 1. Moreover, there is a great diversity of different tests designed to measure these variables. Theoretically it would seem important to include perceptual-motor variables since, as Goodman and Hammill (1973) note, if significant changes are found on other variables, but not these, doubt may be cast on the theory or the findings.

The lack of understanding about what exactly improves as a result of SIT and about the mechanism of change, suggests that studies should include as broad a range of dependent variables as possible. Children's self-esteem and assessments by teachers and parents are measures which have not generally been examined, but which may provide greater understanding of the process of change.

Programme Content

It is also clear that the process of the various perceptual-motor programmes varies considerably between studies. Procedure are variously described as "drawn from sensory integrative therapy...and from Neuro-

Developmental therapy" (Jenkins and Sells, 1984, p.91), and as those "developed by Kephart and Ayres and appropriately modified for application with the preschool retarded child" (Morrison and Pothier, 1978, p.314). Programmes may vary in a number of ways depending on the therapists involved. The warmth of the individual therapists and the amount of fun involved in therapy for the children, for example, may be important factors. It is possible that improvement results largely from the stimulating and enjoyable nature of some programmes. This is likely at least to affect children's self esteem and parents' optimism.

It is likely, as well, that the type of programme offered interacts with the nature of the subject group selected.

Time Factors

In the studies reviewed, not only did the total amount of time involved in experimental programmes vary, but so did the amount of time each day devoted to training programmes and the duration of programmes. Programmes of treatment range from twice a week for six months, resulting in 24 hours of treatment (White, 1979) to a total of 13 training sessions, resulting in 10 hours of treatment (Culp et al, 1980). These are potentially influential variables. It has been suggested, for example, that negative findings may be related to short length of intervention (Ziviani, et al, 1982).

The issue is not clarified, however, by the research studies. Jenkins and Sells (1984) suggested that 10 hours of therapy is as effective as 30 hours of therapy. On the other hand, Shroeder (1982) found that two therapies (SIT

and a perceptual skills programme) were better than one therapy. Most of the SIT programmes discussed are of 15 to 30 hours duration, and more precise guidelines for treatment length cannot be made on the basis of present information.

A further variable of importance is time between training and posttesting, since conceptual development may increase after perceptual deficits have been remediated, or important mediating variables, such as increased ability to attend or great self-esteem may require time to affect measured academic learning (Ziviani et al, 1982). A time delay between training and posttesting would therefore seem desirable. There are only two studies which evaluate the effectiveness of SIT that have left a definite latency period following the end of treatment and before retesting (Ayres, 1972; White, 1979).

Lastly, treatment programmes vary on whether they treat children individually or in groups. Most studies tend to evaluate individual or paired treatment programme, and this is what Ayres herself (1972b, 1978) advocates. However, evaluations of SIT with mentally retarded rather than l.d. children have tended to use small groups (Montgomery and Richter, 1977; Morrison and Pothier, 1972; 1978), which may have influenced results since it has been suggested that this population may require individual perceptual-motor training if these therapies are to be effective (Maloney et al, 1970).

1.3.2 Methodological Weaknesses

The research on SIT is clearly as fraught with

methodological problems, as research on other perceptual-motor theories. The same difficulties that were enumerated by Myers and Hammill (1976), are found in the studies evaluating SIT. For example, only 3 of the 15 studies examined included a group control for the effects of expectations and attention (Montgomery et al, 1977; Morrison and Pothier, 1972; 1978) and in only three studies were perceptual-motor and academic variables fully reported (Jenkins and Sells, 1984; Schroeder, 1982; Ziviani et al, 1982). A significant proportion of studies failed to randomly assign subjects, did not control for trainer variables (such as commitment) and used the same therapists who treated the children for posttesting. A number of studies had inexplicably high subject mortality rates, provided inadequate controls for the effects of regression towards the mean, and provided inadequate information on programme duration and subject selection.

These methodological weaknesses are likely to have affected results. For example, having the same therapists treating and testing subjects, or providing no comparison to determine the effects of expectation, may predispose a study to find positive results. The tendency of the well-designed studies to find negative results and the tendency of the less well-designed studies to find positive results may reflect this relationship.

Some of the methodological difficulties enumerated by Myers and Hammill (1976) and other authors are less likely to affect results and bear closer examination.

A number of authors have been critical of evaluation studies with small subject numbers, and have only examined those studies with greater than 10 or 20 experimental subjects (e.g. Bochner, 1980; Myers and Hammill, 1976). However, a small number of subjects does not in itself invalidate a study. Statistical tests take sample size into account, and although commonsense indicates that findings from small samples should be treated cautiously, statistically significant differences are just as valid when they are obtained from small samples as they are when they are obtained from large samples. Studies with small sample sizes need to be examined with particular awareness of the nature of the subject group, but need not be entirely dismissed.

A further short-coming of perceptual-motor studies listed by Myers and Hammill (1976) was non-equivalence of treatment groups at pretesting on the variables being studied. If random assignment, however, has been followed, then there are statistical procedures which can be used to take into account initial differences between groups.

1.3.3 Conclusions from the Research Studies

An overall analysis of the research on perceptual-motor therapies and SIT reveals a consistent picture: the majority of studies which can be considered well designed, show non-significant differences between groups, whilst a proportion of well-designed studies show equally mixed and positive results

Nutthal (unpublished) has noted a similar, consistent pattern of findings in research evaluating teaching methods. He suggests that this pattern in results over a large number

of studies is a product of situation-specific faults and inadequate definitions of the process involved in the treatments.

There are clearly a great number of ways in which studies evaluating SIT vary from one another and an enormous lack of understanding about how these factors affect results. It is these differences which explain the overall lack of conclusiveness in the findings of the SIT evaluations. Almost all research on SIT has focused on the question of whether SIT is effective or not. It has not sought to answer questions about which of these factors are important to children's learning in therapy.

There are, in fact, so many possible combinations of types of subjects, programmes, dependent variables and other influential factors, that a general answer to the questions of whether SIT is effective or not, can never be found. A specific answer after precise standardisation of all relevant variables is the only result possible. Research studies on SIT are, therefore, more profitably viewed as a series of evaluations of different programmes, rather than attempts to find an absolute answer to the question of SIT's effectiveness.

Summary

SIT (Ayres, 1972a) differs from other perceptual-motor therapies by its greater emphasis on central nervous system etiology, less emphasis on visual skills training, and by being designed to be implemented by Occupational Therapists. Like the other perceptual-motor theories and the Doman and Delacato theory, it is based on questionable

assumptions about the nature of learning disabilities and learning.

Reviews of perceptual-motor approaches have noted the methodological inadequacies of the research. Reviews have found conflicting results in the better designed research, but that these studies are more likely to produce negative findings, than the poorly designed research. Overall, no firm conclusions about the effectiveness of perceptual-motor training can be made (Goodman and Hammill, 1973; Hallahan and Cruickshank, 1973; Hammill and Weiderholt, 1973; Myers and Hammill, 1976).

The conclusions of the reviewers of SIT differ, with both cautious use (Bochner, 1980; Green et al, 1982) and unqualified use with some populations (Ottenbacher et al, 1980) being recommended. Upon examination of the recent research and the research on which the reviews are based, similar conclusions can be made as with the other perceptual-motor approaches: Results of the evaluation studies are conflicting and these studies have not answered a very large number of vital questions about SIT. Most importantly the studies do not provide any clear guidelines about which children are suited to therapy.

Methodological differences between studies may explain the conflicting nature of the findings. Some studies were better designed than others, and studies differed in which dependent variables were measured, which types of children were involved, the nature of the treatment programme, how long treatment lasted, when posttesting was carried out, and whether children were treated individually or in groups.

The number of ways in which studies can vary suggests that an absolute answer to the question of SIT's effectiveness can not be found.

The present study represents an evaluation of one SIT programme and examines the question of who should be selected for therapy.

CHAPTER 2

METHOD

2.1 GENERAL DESIGN

This study occurred in response to a request by hospital authorities to evaluate the occupational therapy SIT programme at Christchurch Hospital. It, therefore, was required to answer questions of a specific nature about the effectiveness of the Christchurch Hospital programme for the children referred to it, rather than questions about SIT in general, for a generalized population of l.d. children.

This research focus had considerable impact on design decisions. It necessitated that the study answer, in the first instance, the following questions:

1. Does the sensory integrative therapy programme at Christchurch Hospital improve children's clumsiness and learning disabilities?
2. What additional benefits does sensory integrative therapy provide over and above a community-based physical education programme?

2.2 THE SUBJECTS

The subjects were 57 5-10 year old children, who were referred to the occupational therapists' sensory integrative programme at Christchurch Hospital between August 1982 and

February 1984. These comprised the entire population of children between these ages referred to the occupational therapy (OT) programme, excluding those early referrals who had been given an urgent rating, and had already been treated, and those children (eight) whose parents decided that their children no longer required therapy. A further seven children were excluded by the investigators and therapists; three because they appeared to have no sensory integrative difficulties following testing on the SCSIT, two because of their concurrent involvement in other intervention programmes, one because her motor problem was due to physical handicap, and one because of mental retardation and difficulties with testing. The remaining subjects exhibited a wide array of handicapping conditions including mild mental retardation, behavioural disturbance, mild cerebral palsy and epilepsy. These 57 children were randomly assigned to three groups of 19 children each, (a) the occupational therapists' sensory integrative treatment group (OT),

Table 2 Reasons for Referral to OT Programme

Treatment Group	Co-ordination problems	Learning Disabilities	Attention deficits	Social Skills and Behavioural problems	Perceptual problems	Speech problems	$\bar{x}$
NT	15	5	3	4	2	5	1.39
OT	17	8	3	4	5	2	2.05
PE	14	5	3	5	3	4	2.00
Total	46	18	9	13	10	11	1.95

Note: The maximum number of reasons recorded was three per subject.

(b) a physical education control group (PE) and (c) the no-treatment control group (NT). Subsequent to group assignment, two children from the physical education control group were withdrawn from the study by their parents.

Children were referred to the OT programme predominantly because of perceptual motor difficulties (84%) and learning disabilities (33%). Table 2 presents the reasons for referral to the OT programme as noted on the referral letter, with a maximum recorded number of reasons of three per subject.

Of the 55 children in the research programme, 10 were female and 45 were male.

Table 3 Characteristics of Experimental and Control Groups Prior to Posttesting

	Group			
	NT	OT	PE	Total
N	19	19	17	55
Female N	3	4	3	10
Age[a] ($\bar{x}$)	7.2	7.5	7.2	7.3
SD	1.6	1.3	1.4	1.4
Sessions ($\bar{x}$)	0	17.42	16.0	-
SD		0.50	1.8	-
Special Class	0	3	0	3
Programme before	5	4	10	19
S.E.S.[b] ($\bar{x}$)	3.5	3.6	3.5	3.5
SD	1.6	1.4	1.1	1.3

[a] Age as at 1 February 1984

[b] S.E.S. is based on Elley and Irving Index (1976)

The average age of the subjects (on 1 February 1984) was seven years three months. At the time of pretesting, three children were enrolled in special classes, ten were attending private schools and ten were attending schools outside metropolitan Christchurch. A third of the children (19) had received some previous treatment for their perceptual-motor disabilities, such as home programmes (list of suggested activities for parents to implement) or a group programme at school, or an individual motor programme based at the local Teachers' College. One child had already spent three months in the OT programme at the Hospital.

Table 3 presents the mean age, number of sessions attended and socio-economic status levels and the sex, special class and prior treatment distributions for the OT, PE and NT groups. There is little variation between groups in socio-economic status, based on the Elley and Irving Indexes (1976, 1977).

Table 4 presents the socio-economic status levels of the 55 subjects based on their fathers' and their mothers' occupations. Referrals to the OT programme came from all levels of socio-economic status, with a slight preponderance at the lowest level if beneficiaries are included at level 6.

The frequency with which subjects were involved with other remedial agencies prior to, and including pretesting is presented in Table 5. Speech Therapy clinics were the most frequently attended other treatment agencies. Subjects in the OT group attended more remedial agencies, on average, than subjects in the NT and PE groups. The largest differences between groups was in the frequency of contact with school psychologists and medical specialists.

Table 4 Number of Subjects at each level of Socio-economic status, based on Fathers' and Mothers' Occupation, Scale: highest 1, lowest 6.

	1	2	3	4	5	6	Other[a]	Total
SES based on Fathers' occupation	2	11	12	13	6	5	5	54
SES based on Mothers' occupation	2	3	6	9	4	7	23	54

Note: SES is determined on the Elley and Irving Indexes (1976), (1977)

[a] Other includes father on unemployment or sickness benefit, or employment unknown. Mother a housewife.

Table 5 Frequency of Involvement with Other Agencies prior to and at Pretesting

Group	N	Speech Therapist	Reading Teacher	Child and Family Guidance	School Psychologist	SPELD	Health Camp	Ward 24	Perceptual motor programme	Medical Specialist or Optometrist	Other	Total	$\bar{x}$
NT	19	12	5	1	5	3	2	0	3	7	7	45	2.37
OT	19	14	6	4	14	6	2	1	2	12	8	69	3.63
PE	17	8	7	3	10	0	2	0	2	8	5	45	2.65
Total	54	34	18	8	29	9	6	1	7	27	20	159	2.89

Although children were referred to the OT programme for either learning disabilities or perceptual-motor problems, a very large proportion of the children had difficulties both with school subjects and with motor activities, according to questionnaires administered to their teachers and their parents. Fifty-four of the fifty-five children were described by their teachers as having difficulties with school subjects. The same number of children were described by either their teachers or their parents as being unco-ordinated or clumsy. A large proportion of the children (89%) were reported to have evidence of social or behavioural problems either at school or at home and a similarly high proportion (89%) were described as having difficulties with concentration. According to their teachers, about half the children had problems with copying from the blackboard. Speech problems were reported in 85% of the children and 60% had attended speech therapy. According to their teachers 78% of the children were estimated to be average or above average in intelligence.

At posttesting it was found that one child from the PE group had moved to another city. This left a total of 54 children; 19 in the OT group, 16 in the PE group and 19 in the no-treatment control group.

2.3 PROCEDURE

Pretesting was conducted in February 1984 by the two paediatric occupational therapists at Christchurch Hospital and by an assistant clinical psychologist, who had teaching experience. Each subject had three assessment sessions: two with an occupational therapist and one with the assistant clinical psychologist. So that equal numbers of old and

young children of each sex were assigned to all groups, subjects were ordered according to their age,and then divided into two groups about the midline(which was 88 months). Having been stratified according to age and sex, subjects were randomly assigned to either OT, PE or NT groups. Table 6 shows the number of old and young subjects of each sex in the three groups.

Table 6 Number of old and young subjects of each sex in treatment groups

Group	Old Ss		Young Ss	
	Female	Male	Female	Male
NT	1	8	2	8
OT	2	8	2	7
PE	1	8	2	8

Note: Old subjects are those children who were aged 88 months or more on 1st February, 1984. Young subjects are those aged less than 88 months.

The OT and PE programmes began in March and continued until the second week in July, excluding a two week May vacation. The mean number of training sessions, each of an hour's duration, was 17.4 for the children in the OT group and 16.0 for the children in the PE group. Posttesting began in October 1984 following a 12 week latency period and lasted four weeks. The psychologist and two occupational therapists who had had no contact with the experimental programme, and did not at the time work at Christchurch Hospital, conducted posttesting. Examiners at both pre and posttesting were, so far as possible, unaware of the experimental or control group status of the subjects. Partciular care was taken at post-

testing so that the children did not inadvertently reveal their group membership. Each subject was approached before assessment sessions by a research assistant who was not involved in testing, and asked if they could "keep a secret" about their group involvement. In a high proportion of cases this was successful. Following posttesting the children in the PE and in the no-treatment groups received the OT treatment.

2.4 MEASUREMENT OF DEPENDENT VARIABLES

The following instruments were individually administered to each subject as pre and posttest measures.

2.4.1 Language

The Bankson Language Screening Test (BLST) (Bankson, 1977)

The BLST consists of a battery of 17, nine-item subtests organized into five general categories: semantic knowledge; morphological rules; syntactic rules; visual perception; and auditory perception. The test was developed to measure expressive language and the psycholinguistic and perceptual skills on which this is based. The test is suitable for children from four to eight years, but is more sensitive to developmental differences at the lower end as opposed to the upper end of the age spectrum (Bankson, 1977). Test reliability is reported to be between .94 and .96. In terms of validity correlations between BLST and other widely used language tests range from .54 to .64 (Bankson, 1977). The BLST has also been found to accurately identify children who had been firstly diagnosed as language impaired through

analysis of a 50 sentence speech sample, (Blaxley, Clinker and Warr-Leeper, 1983).

2.4.2 Perceptual-motor and Sensory Integrative Skills

Southern California Sensory Integration Tests (SCSIT) Ayres (1972c)

This battery of 17 subtests was used in the study as a pre and posttest measure and, in the OT group children, to establish the patterns of deficits on which their individual intervention programmes were based. It is designed to help diagnose children's dysfunctions in the areas of form and space perception, tactile perception, postural and bilateral integration and motor skills. Tests are referred to in their abbreviated form, the full titles of which can be found in Appendix V.

The tests, however, have a number of limitations. Firstly the normative data is of questionable value (Westman, 1978) and may not be applicable to New Zealand populations (Ritchie, 1985). The test retest reliabilities range from .01 to .89 (Ayres, 1980) which as Bochner (1980) argues, may limit the usefulness of some tests. It is suggested before interpreting results, that the standard error of measurement and the reliability of each test be checked for age related versus random variability, before crediting a score with significance (Ayres, 1980; Westman, 1978). As Ayres (1980) notes, the tests are limited by ceiling and floor effects. The motor accuracy (MAC) and digit copying (DC) subtests are the most reliable subtests, but DC can improve with previous practice (Ayres, 1976; Westman, 1978).

The validity of these tests and their related syndromes

have, furthermore, not been well established (Bochner, 1980; Reed, 1978; Westman, 1978).

A number of studies evaluating SIT have used SCSIT scores for diagnosis and treatment planning, but have not reported these scores (Ayres, 1972b; 1978; White, 1979; Ziviani et al, 1982). Other studies have reported only some subtests (Ayres, 1977; De Pauw, 1978; McKibbins, 1973). Bochner (1980) suggested this failure to report SCSIT scores is a function of the tests' low reliability.

The SCSIT scores are included here, despite their low reliability, since they are the tests used by the occupational therapists at Christchurch Hospital for diagnosis, treatment planning, and assessment of progress in treatment.

Since group means of MAC-R and MAC-L each contained scores from subjects' dominant and non-dominant hands, which SIT theory predicts to improve differentially through treatment, these scores were recombined into Motor Accuracy for the dominant hand (MAC-Dom) and motor accuracy for the non-dominant hand (MAC-NDom).

2.4.3 Reading

Reading Age, Self Correction Rate and Analysis of Miscues (Clay, 1979; Brennan, 1977; Goodman & Burke, 1972)

Letter Identification, and Word Tests (Clay, 1979)

Each child read a sample of prose extracts that were below, at and above their reading age, and their reading miscues were recorded. The passages were taped for later reliability checks. Reading ages were computed by establishing

the difficulty level of the extract at which the children read with 95% accuracy (instructional level) (Clay, 1979). This gave a very detailed record of each child's reading behaviour, and also had the advantage of being applicable to a broad range of reading abilities. Each child's self correction rate for instructional and hard material was calculated (Clay, 1979). This gives a measure of the extent to which the child is using reading cues and is reading for meaning. It is an important indicator of good reading (Clay, 1979). An analysis was performed of miscues to determine the proportion that were semantically, graphically, phonically, and gramatically similar to the word in the text (Brennan, 1977). A copy of this miscue analysis record can be found in Appendix VI. The percentage of words omitted was included as a measure of eye-muscle difficulties, since a high proportion of children missed entire lines. To check the reliability of the reading age measures, one quarter of the subjects were randomly selected and their miscues recoded from the taped reading passages by a second rater. The interrater reliability for number of miscues, calculated by dividing the number of agreements by the total number of agreements and disagreements was 82%.

For children who were aged between five to seven years, and who were reading between the emergent and five and a half years level, a letter identification and a word test (Clay, 1979) were also administered. This gave a more accurate and sensitive measure of these children's reading development. In the letter identification test children were asked to identify the lower and upper case letters of the alphabet.

The word test is a list of 15 words compiled from the 45 most frequently occurring words in a common early reading series. This was found to be a very good instrument for ranking or grouping children doing the first year of instruction and for retarded readers in the second year (Clay, 1966).

2.4.4 Handwriting

Writing Analysis Coding Schedule

The instrument used to measure difficulties with the fine motor co-ordination involved in handwriting was a specially constructed coding schedule, based on the Slingerland Screening tests for Identifying Children with Specific Language Disabilities (Slingerland, 1970) and the Purdue Perceptual-Motor Survey (Roach and Kephart, 1966). Children wrote their name and address and then copied either one of two writing samples (depending on age level) within a ten minute time limit. The total number of letters or letter like shapes were then totalled and the sample errors were coded according to 17 categories which were grouped according to whether they were perceptual errors (e.g. reversals, inversions), letter misformations (e.g. incompleteness of letters, choreoathetosis) or spacing or word order errors (see Appendix IV for writing analysis record sheet). Two examiners were trained in the use of the coding schedule and they separately coded all writing samples. Where there was disagreement, an average of the two figures was taken as the final score. The interrater agreement for the total number of errors was

88.3% and ranged from 83.9% to 86.2% in the three grouped categories. Subcategory agreement ranted from 42.9% to 91.7%. The number of errors was divided by the total number of letters recorded, to adjust for the time factor. This is referred to as the writing error ratio. Correlations between the writing error ratio and Southern California Sensory Integration Motor Subtests range from .53 to .69.

2.4.5 Self Esteem

The Culture-Free Self Esteem Inventory for Children, Form A (Battle, 1981)

This is a self-report scale developed to measure an individual's perception of self, and includes 50 items relating to school, peer, parent, and general self esteem issues and ten lie items. It may be administered in a group form, but individual administration is recommended by the author for children in grades 1 or 2, and this procedure was followed for the entire group of children in the study. Test retest reliability for elementary children ranges from .72 to .93 (Battle, 1982). This test was selected because of its applicability to a wide age range and because it has been used in research on learning disabilities and special class children before (Battle, 1975; 1979; 1980). Correlations with the Coopersmith Self-Esteem Inventory (Coopersmith, 1977) range from .66 to .91 (Battle, 1977).

2.4.6 Behaviour, Social Adjustment and School Progress Teacher and Parent Questionnaires

Parent and teacher perceptions of behaviour, social adjustment and school progress were measured by the use of

two separate questionnaires. Individual interviews of the parent (or parents) who filled in the questionnaire, and also each child's classroom teacher,were conducted. Information on the child's previous and present involvement in additional treatments, such as remedial reading was sought from both the above sources at this time and a sample of this information checked for accuracy against school records and the records of Psychological Service. Teachers were asked to rate the child's abilities at reading, spelling, handwriting, mathematics, physical education, writing, language and speech on a five point scale, and both parents and teachers were asked to indicate on a four point scale the frequency of a number of social and classroom behaviours. Two measures summarising this questionnaire data were used in the evaluation. The first, referred to as Teacher and Parent Problem Total (TPPT) was the total number of problem areas noted by the teachers and parents about the subjects in initial unstructured questions about the subjects' problems. Secondly, from the teachers' questionnaire, teacher rating totals (TRATE) were calculated by totalling the subject ratings noted above. Copies of the Teacher and Parent Questionnaires can be found in Appendix III.

2.5 INTERVENTION PROGRAMMES

2.5.1 The OT Group

Procedures developed predominantly by Ayres (1972a), but also by Bobath and Bobath (1976), Kephart (1960) and Rood (1962) were followed with the subjects of this group. It is therefore more aptly referred to as an occupational therapy programme rather than a programme of SIT. Subjects

were given individual therapy once a week for an hour for an average of 17.4 weeks, by two experienced paediatric occupational therapists (with an average of 3.5 years experience in this area). This corresponds to the number of treatment sessions generally given by the OT's at Christchurch Hospital. Prior to treatment each child in the group was further assessed in a clinical observation session, which provided extra information for the formulation of the individualized therapy programmes. On the basis of the clinical observations and the SCSIT data the two paediatric OT's diagnosed sensory integration syndromes and developed remedial programmes for each subject. These sensory integrative syndromes for the OT group and for the PE and NT groups (devised following posttesting) are summarised in Table 6. The three main areas of dysfunction for each subject are recorded in Appendix II in their complete form.

The training programmes involved activities to enhance vestibular, proprioceptive and tactile functioning, activities to improve balance, fine and gross motor skills, integration of both sides of the body and integration of postural reflexes (Ayres, 1972a) and activities to strengthen muscle tone (Bobath, 1976; Rood, 1962). These included activities such as riding a scooter-board prone down a ramp, a variety of games involving fine motor skills (such as puzzles), balancing in different body positions on equilibrium boards, swinging prone in a body sling, obstacle courses, rolling in blankets, crawling through towelling tunnels, hitting a swinging ball, hopscotch, bouncing on a tyre and balance beam work.

The therapists communicated frequently with the subject

Table 7 Main Areas of Sensory Integrative Dysfunction

Treatment Group	Areas of Sensory Integrative Dysfunction								
	Vestibular	Somato-sensory	Visual and form and space	Dispraxia	Motor Control	Lateralisation	Left or right hemisphere	Primitive reflexes	Behaviour
NT	4	15	5	9	13	6	1	2	2
OT	10	9	7	2	16	4	1	2	6
PE	7	13	5	5	10	5	0	4	2
Total	21	37	17	16	39	15	2	8	10

Note: Three areas of sensory integrative dysfunction are recorded for each subject.

during activities, and also introduced various language concepts. For example the therapist might emphasize the different coloured parts of a puzzle. Both therapists had a warm enthusiastic manner with the children and sessions tended to have a "fun" atmosphere. Most often a child's parent remained to observe or occasionally participate in acvities during the session.

Prior to each session the OT's recorded the aims of the session and which activities they intended to include, and following the session they noted what in fact had been covered and general comments on progress. A copy of this activity recording sheet can be found in Appendix VII. Approximately half way through the therapy programme and again at the end, parents and teachers received a report on the child's progress. A summary of treatment was also provided for the referral source.

Following therapy, 14 out of the 19 children in the OT group received a home programme. These were individually designed for each subject and included a selection of activities from the therapy programme, which could be done at home, (see Appendix VII for an example of these home programmes). The five children who did not receive a home programme were excluded on the judgement of the OT s because it was considered that there was a very low probability of any programme being carried out in the home. In one case where the parent was a teacher, the programme was given verbally, rather than in the written form. Home programmes are a typical element in the treatment procedures of the OT treatment at Christchurch Hospital.

2.5.2 PE Group

Procedures outlined in the New Zealand Department of Education publications on physical education were followed with the subjects of this group. The aims, activities and format were the same as those recommended to be carried out in physical education periods in all New Zealand primary schools. The 17 children in this group were divided into three classes on the basis of age. Two classes of five subjects each were held in the morning and one class of seven subjects for the eldest children was held in the early afternoon. All three classes were taken by a trained physical education teacher who was a retired physical education adviser to schools, and was fully committed to the value of remedial physical education for clumsy children. Children were again withdrawn from their regular classes and brought to a central gymnasium by their parents or, in three cases, by a volunteer helper.

The training programmes, as recommended by the PE curriculum, varied according to the age level of the subject groups. Each training session involved a fitness component lasting 10-15 minutes, a skills teaching and practice component lasting 30 minutes and a game component lasting 5-10 minutes. Skills units that were taught, included small and large ball handling, summer and winter game skills (senior group), agilities and folk dancing (two junior groups). The fitness component involved running, skipping and jumping activities, followed by fitness exercises (such as bend-claps). The skills and practise component involved activities such as skipping, galloping, ball catching and throwing, forward rolls, and bunny jumps. The game component involved games

such as "stop ball rounders" and the "mouse and the cheese". Emphasis was more on gross motor skills than fine motor skills, (see Appendix VII for complete aims of the PE programme).

Verbal communication was a component of this treatment and instructions involving concepts of size, order and direction were frequently used. Parents at times became involved in teaching skills and participated in fitness activities. A chart with stars was used to help motivate the children.

Prior to each session the PE instructor recorded the aims and activities for each class, and following this session she noted what had been covered in the class. Approximately half way through and at the end of the treatment programme parents and teachers received a report on the child's progress. Following therapy the 17 children and their parents in the PE programme received a home programme which was designed for the children as a group and included activities to develop the skills taught in the PE programme that could be done at home, such as forward rolls and throwing balls against walls. A copy of this home programme can be found in Appendix VII.

The PE programme was similar to the OT programme in its emphasis on enjoyable physical activity, parental involvement and language concepts. As with the OT programme, it resulted in subjects being removed from the normal classroom programme, and is likely to have had a similar effect on the expectations of parents, children and classroom teachers. A major difference between the two programmes was that the PE programme aimed at teaching specific gross motor skills, whereas the OT programme had the more developmental aim of integrating sensory input. It further differed from the OT

programme in providing a more serious "classroom atmosphere", and in its therapist to child ratio.

Such a group programme, although differing in more than one way from the OT treatment programme, is a realistic alternative for parents,and provided an alternative treatment paradigm. Children in the PE group were given the OT programme immediately following posttesting.

2.5.3 The No-treatment Control Group

These children had no contact with the OT programme between pretesting and February and posttesting in October. The children did, in the natural course of their schooling, come in contact with the educational remedial systems. These contacts were recorded at posttesting. Children in the NT group were also given the OT programme following post-testing.

CHAPTER 3

RESULTS

3.0 INTRODUCTION

The results obtained from this study have been reported in three sections. In the first section information is provided about the scores of the three groups on pretest measures, and about the nature of the measures themselves.

In the second section the effect of the OT treatment on the various outcome measures is compared with the effects of the PE treatment and the results obtained from the no treatment control.This comparison was based on an analysis of the posttest scores corrected for differences in pretest scores and for age.

The third section reports on attempts to determine which factors were most closely related to children's progress during the OT programme and which of the children were most likely to benefit from the kind of treatment offered. Also included in this section are the data obtained from teachers and parents in questionnaires and information about the children's involvement with other agencies between pre and posttesting.

3.1 PRETEST SCORES AND MEASURES

3.1.1 Pretest Scores

Table 8 presents the pretest means of the Southern

Table 8 Pretest Means of Perceptual-Motor Measures (adjusted for age) and Significance of Between Group Differences

	Group NT	OT	PE	F.Ratio	Df
SCSIT					
PS	14.22	12.18	14.14	1.99*	2/53
DC	8.48	7.96	9.39	0.49	2/53
GRA	8.41	8.64	7.83	0.26	2/53
IP	10.16	9.96	11.05	0.40	2/52
MAC-Dom	141.96	135.30	143.46	4.19**	2/53
MAC-NDom	133.47	131.91	135.22	0.46	2/53
SV	16.13	16.06	14.72	0.47	2/53
FG	14.58	14.26	14.58	0.05	2/53
KIN	61.20	54.54	53.20	1.76*	2/52
MFP	6.33	6.63	6.09	0.23	2/53
FID	9.41	7.82	8.93	1.36	2/53
LTS	77.73	74.73	79.18	2.03*	2/51
DTS	29.28	26.20	27.15	2.09*	2/53
BMC	11.94	7.64	9.35	7.20***	2/48
SBO	20.33	20.57	28.37	0.61	2/53
SBC	5.48	4.79	6.68	0.90	2/50
CML	15.68	16.77	16.50	0.17	2/52
CMLX	13.06	13.28	12.45	0.11	2/52
RLD	10.69	12.31	11.82	0.46	2/53

* $p<.20$

** $p<.05$

*** $p<.01$

California Sensory Integrative Test scores adjusted for age. The significance of the differences between the groups was examined using analyses of variance with age as a covariate (Keppel, 1982). Since age was used as a covariate in the posttest analysis, it was also used in the comparison of pretest scores in order to maintain the same standard of comparison.

Age was used as a covariate in the comparison of posttest scores because it was evident that most of the measures showed a significant correlation with age. Thus although individuals were randomly assigned to groups within two age categories (above 87 months, 87 months and below) and the average age of each group was closely equivalent (see Table 3), most of the measures were clearly affected by age development. Using age as a covariate ensured that any difference between groups in the effect of development was minimised.

Two of the differences between groups on the SCSIT subtest pretest scores were found to be significant. These were the Bilateral Motor Coordination test ($F = 7.2$, df 2/48, $p<.005$) and the Motor Accuracy-Dominant test ($F = 4.15$, df 2/53, $p<.05$). On four other Southern California Sensory Integrative tests (Kinesthesia, Localisation of Tactile Stimuli, Double Tactile Stimulation and Position in Space) differences between groups were also large enough to cause concern. On most of these tests it was the OT group which had the lowest adjusted mean.

Table 9 presents the adjusted pretest means of the language, reading, self esteem, handwriting and questionnaire summary measures. On the reading word test (which was only

Table 9 Pretest Means of Non-motor Measures (adjusted for age) and Significance of Between Group Differences

	Group NT	OT	PE	F.Ratio	Df
Handwriting[a]	.96	.97	.94	0.02	2/52
Reading	6.39	5.94	5.99	0.59	2/53
Reading word test	4.97	1.94	7.99	8.10*	2/25
Reading letter test	28.77	23.62	29.24	0.32	2/25
Language	109.65	104.97	107.18	0.25	2/53
Self esteen	29.95	27.71	30.43	0.62	2/46
TPPT[a]	15.23	16.44	14.79	0.63	2/53
Teacher ratings[a]	26.57	26.26	26.72	0.06	2/53

[a] On these measures 0 is the highest possible score

* $p<.01$

administered to a sample of children in each group) the differences were highly significant with the OT group having clearly the lowest mean.

The procedure for group assignment, which was to assign children randomly to treatment groups after stratification for age and sex, offers no explanation for the differences in mean perceptual-motor scores. This procedure ensured that each child had an equal chance of being exposed to either the treatment or control conditions. However, random assignment does not ensure equality of groups on all variables. Where differences do occur by chance, careful note should be made of these differences when evaluating the results. In this study, analysis of covariance was used to determine the significance of the treatment effects and these pretest differences were taken into account by including the pretest scores as covariates in the analysis.

Comparisons between the groups' adjusted posttest means were examined using the Scheffé method. The Scheffé test was chosen above the T-method, and the T-test because of its sensitivity and because it can be used when subject numbers in treatment groups are unequal (Glass and Stanley, 1970).

3.1.2 Interpretation of Measures

Throughout the results, SCSIT raw scores, or in some cases pretest adjusted raw scores, have been reported rather than standardised scores because of the previously noted inadequacies of the standardised scores.

On the measure of handwriting, the writing error ratio, younger children tended to make more errors than older children, and therefore had higher ratios. The scores on

this test ranged from .11 (which represents one error in ten words) to 2.04 (two errors per word).

Reading. Reading age was the principle measure of reading (see Appendix VI for the Reading Age Scale). Students' reading ages ranged from emergent (non-reading) through to 14 years at posttesting. However, because the step between reading at the emergent level and reading at the beginner reader level is quite different from other intervals, (for example the interval between reading 5½-6 year material and 6-6½ year material), the progress of readers who were reading at the emergent level at the time of pretesting, is analysed both separately from, and together with the progress of other readers. Some of the readers at the emergent level were over six years old and some were as old as eight or nine years. The progress of these older children at the emergent level has also been examined separately because they represented seriously retarded readers whose progress could be especially significant.

The children who were reading at 5½ years or less and who were under 8 years of age, at the time of pretesting were administered the word recognition and letter identification tests, as well as the running record. Those administered this test, therefore, included all of the children except three who were at the emergent readers level at pretest (n = 20), along with a number of children who were just beyond the emergent level (n = 5).

The results of the reading miscue analysis and the self correction rates were analysed by comparing the frequency of those who made some progress between pre and posttesting, with those who made no progress in the three

different experimental groups. Chi square was used to determine whether the number making some progress in one group was significantly greater than the number making progress in the other groups. Although this is a much less sensitised form of analysis than the analysis of covariance used with the other criterion measures, these reading measures were significantly skewed and did not conform to the assumptionsnecessary for analysis of covariance.

Questionnaire Measures. For the major analysis, teacher and parent questionnaire information was summarised in the Teacher and Parent Problems Total (TPPT) and totalled Teacher ratings of subjects (TRATE). For both these measures, a lower score represents progress. Scores on the TPPT ranged from 6 to 24. This score represents the total number of problem areas noted by a child's teacher and parents. If, for example, both parents and teachers noted co-ordination, speech and concentration as problems, this would give a TPPT score of six. Scores in TRATE ranged from 17 to 33. This was the total of the teacher's ratings of the child's performance in reading, spelling, handwriting, mathematics, physical education, written language and speech. Each rating was on a five point scale, where excellent was scored one, and very poor was scored five. A TRATE score of 17, therefore, represents a mean rating of 2.4 which corresponds to performance in the seven areas which was slightly above average.

3.1.3 Reliability of Measures

Although reliabilities have been reported in the

literature for most test procedures used in this study, many of the children in the sample had a range of physical and emotional problems which could have adversely affected their test scores. For this reason it was decided to attempt to obtain independent estimates of the reliability of the measures used. Moreover, the reliability of the handwriting error ratio had never been established. No procedures designed especially to check reliability were carried out, but pretest/posttest correlations were taken as an approximate indication of reliability. Tests were considered to have an adequate reliability, assuming no floor and ceiling effects, if they showed pretest/posttest correlations of 0.5 or above, for each group. Scattergrams of the distribution of pretest and posttest scores for each group on all measures were examined for floor and celing effects and to check whether the distributions of scores were relatively consistent between groups.

Table 10 presents pretest-posttest correlations on all measures for each of the three groups. Those measures listed in the upper portion of Tables 10, 11 and 12 are those which were considered acceptable on the above criteria. In subsequent tables only these measures were reported.

3.1.4 Subjects' Scores

Examination of the scattergrams also revealed that the scores of three subjects (one from each group) appeared to be especially unreaiiable. One of these subjects had recent onset of epilepsy and two of the subjects were suffering from the initial stages of measles. On the Double Tactile Stimulation test the score of the child with

epilepsy, for example, fell from 20 at pretesting to 8 at posttesting. This represents a decrease of more than two standard deviations. The scores of two of these subjects were excluded from the analysis of all measures except the Questionnaire summary measures. The scores of one of the subjects with measles were excluded from those perceptual-motor tests which were affected by the measles.

There were five other children whose results needed to be treated with caution. One child in the PE group was found at the time of the posttests to have received SIT privately during the treatment period. One child in the control group had been given a detailed home programme by the OTs prior to the study. This child's parents had carried out the programme very thoroughly. Following posttesting the OTs conducted clinical observations of the children in the PE and NT groups. The results of these observations, along with the SCSIT scores revealed three children whom the OTs considered had insufficient SI problems to warrant treatment.

The effect of the OT programme without these children's scores has been examined separately in the final section of these results, as part of the discussion of the suitability of children for treatment. In all other analyses, scores of these children have been included.

Did the subjects in the study show perceptual-motor delay? All children other than the three noted above, were considered by the OTs to have sufficient SI problems to warrant treatment.

This is confirmed by an examination of children's

Table 10 Pretest/Posttest Correlations

Variable	Group NT	OT	PE	Total
Handwriting	0.85	0.74	0.93	0.83
Reading Age	0.99	0.98	0.97	0.98
Reading Word Test	0.66	0.50	0.75	0.63
Language	0.92	0.96	0.96	0.94
Teacher and Parent Problem Totals	0.53	0.52	0.53	0.51
SCSIT				
P.S.	0.77	0.80	0.78	0.78
D.C.	0.81	0.92	0.93	0.89
GRA	0.56	0.68	0.68	0.64
I.P.	0.62	0.81	0.63	0.69
MACR	0.83	0.90	0.75	0.81
MACL	0.88	0.88	0.81	0.86
MAC-Dom	0.85	0.84	0.83	0.79
MAC-NDom	0.87	0.90	0.71	0.84
S.V.	0.76	0.33	0.56	0.57
F.G.	0.61	0.59	0.45	0.54
KIN	0.42	0.19	0.74	0.39
M.F.P.	0.37	0.48	0.72	0.50
F.I.	0.59	0.57	0.23	0.49
L.T.S.	0.69	0.32	0.51	0.61
D.T.S.	0.30	0.67	0.75	0.62
B.M.C.	0.48	0.68	0.75	0.70
S.B.O.	0.85	0.85	0.41	0.63
S.B.C.	0.47	0.56	0.33	0.36
C.M.L.	0.30	0.65	-0.27	0.28
C.M.L.X.	0.65	0.58	0.27	0.50
R.D.L.	0.25	0.54	-0.09	0.27
Self Esteem	0.18	-0.10	0.20	0.09
Reading Letter Test	0.62	0.86	0.63	0.68
Teacher Ratings	0.42	0.82	0.65	0.64

Note: Scores of Subjects 01 and 04 are excluded.

Table 11 Means ($\bar{x}$) and Standard Deviations (SD) of Pre- and Post test Scores on All Measures

		Group					
		NT		O.T.		P.E.	
		$\bar{x}$	S.D.	$\bar{x}$	S.D.	$\bar{x}$	S.D.
Handwriting Error Ratio[a]	Pre	1.00	0.66	0.92	0.58	0.96	0.57
	Post	0.65	0.45	0.76	0.52	0.65	0.62
Reading Age	Pre	6.29	2.18	6.06	1.73	5.95	1.43
	Post	6.87	2.58	6.67	2.38	6.39	1.67
Reading Word Test[b]	Pre	3.70	4.11	3.60	3.53	7.42	6.08
	Post	8.70	5.08	9.22	4.49	8.75	6.16
Language (BLST)	Pre	107.74	29.28	107.42	32.46	106.58	33.00
	Post	116.26	23.27	114.47	28.09	119.56	24.61
Teacher and Parent Problem Totals[a]	Pre	15.16	4.27	16.53	4.41	14.77	5.26
	Post	9.00	2.61	8.47	1.98	8.88	3.03
SCSIT							
P.S.	Pre	14.05	5.45	12.47	5.86	13.88	4.00
	Post	16.05	4.34	15.68	5.12	16.94	1.62
D.C.	Pre	8.84	12.01	8.16	6.35	9.59	5.98
	Post	9.84	4.56	9.26	6.21	10.50	5.9
GRA	Pre	8.21	3.88	8.89	4.48	7.77	4.38
	Post	10.15	3.70	9.79	5.40	7.31	4.92
I.P.	Pre	9.89	4.24	10.17	4.89	10.94	5.61
	Post	11.21	4.09	11.50	5.52	11.50	4.20
MACR	Pre	140.68	12.46	133.68	13.32	139.18	12.22
	Post	143.56	10.12	139.00	12.37	140.25	12.43
MACL	Pre	133.63	14.00	134.95	11.20	139.17	10.05
	Post	135.89	11.05	134.68	10.98	137.31	10.16
MAC-Dom	Pre	141.37	12.43	136.05	12.34	143.29	10.11
	Post	144.44	9.15	140.16	11.79	140.56	12.83
MAC-NDom	Pre	132.95	13.63	132.58	12.05	135.06	10.59
	Post	135.00	11.17	133.53	11.01	137.00	9.54
S.V.	Pre	15.95	6.19	16.21	5.37	15.17	5.00
	Post	15.95	6.87	17.53	5.21	16.62	5.91
F.G.	Pre	14.42	4.56	14.42	3.93	14.53	3.54
	Post	15.84	4.21	15.63	3.20	14.56	5.02
KIN	Pre	60.05	12.85	58.61	14.83	52.71	17.34
	Post	61.42	14.73	60.28	10.82	57.19	12.14
M.F.P.	Pre	6.31	2.85	6.74	2.49	6.06	3.34
	Post	7.42	2.09	7.42	2.50	7.69	2.87
F.I.D.	Pre	9.26	3.48	8.32	3.73	8.82	3.61
	Post	9.52	3.17	9.21	3.29	7.50	3.67
L.T.S.	Pre	77.52	6.29	75.33	8.66	79.50	4.52
	Post	77.00	8.68	75.95	6.84	77.40	7.08
D.T.S.	Pre	29.16	3.51	26.11	6.81	27.00	4.74
	Post	30.05	3.44	29.17	5.11	28.37	6.70

Table 11 (Continued)

B.M.C.	Pre	11.44	3.43	7.88	4.66	9.33	4.29
	Post	9.79	3.90	6.56	4.95	6.50	4.47
S.B.O.	Pre	19.21	16.13	22.00	30.86	28.12	37.25
	Post	32.63	30.18	45.83	81.64	30.31	23.97
S.B.C.	Pre	5.10	4.7	5.18	4.68	6.56	6.22
	Post	6.63	4.04	11.24	13.62	6.31	3.46
C.M.L.	Pre	15.58	5.84	16.89	6.6	16.47	5.32
	Post	19.37	4.50	17.94	6.49	17.50	6.94
C.M.L.X.	Pre	12.89	5.86	13.5	6.73	12.42	4.80
	Post	17.37	5.42	16.88	6.88	15.88	7.27
R.L.D.	Pre	10.53	6.11	12.53	5.63	11.77	5.23
	Post	13.16	5.80	12.44	6.05	12.44	4.23
Self Esteem	Pre	29.53	6.21	27.43	7.44	30.33	6.70
	Post	36.47	7.71	36.65	7.90	38.25	5.81
Reading Letter Test	Pre	26.20	18.53	28.00	18.47	27.50	19.25
	Post	46.30	12.10	41.00	12.74	46.00	11.97
Teacher Ratings[a]	Pre	26.53	3.03	26.32	5.5	26.71	3.72
	Post	24.88	4.47	26.31	4.6	24.54	3.1

[a] On these measures zero is the highest possible score

[b] Beginner readers only

standard scores at pretest on each of the six reliable SCSIT subtests. A standard score of -1.0 or less was taken as an indication of significant perceptual-motor problems. There were only three children who did not show this level of deficit on one of the reliable SCSIT subtests.

3.2 COMPARISONS BETWEEN GROUPS AT POSTTESTING

Table 11 presents unadjusted means and standard deviations for pre and posttest scores for each group on all measures. To determine the significance of the differences between groups the posttest scores of the three groups on each of the measures were subjected to analysis of covariance with pretest scores and age as covariates. Table 12 contains the posttest means for each group adjusted for pretest and age, and the F-ratio and significance level of the between group differences.

Perceptual-Motor, Language, Handwriting, Self Esteem and Teacher and Parent Questionnaire Summary Measures. No significant differences between groups were found on the Southern California Sensory Integrative Tests, the Bankson Language Screening Test ($F = 2.59$, df 2/49), the handwriting error ratio ($F = 0.38$, df 2/47), the Culture Free Self Esteem Inventory ($F = 0.68$, df 2/43), the Teacher and Parent Problem Total ($F = 1.45$, df 2/49) and the teacher ratings of subject areas ($F = 0.65$, df 2/48).

Reading Measures

Reading Age. No significant effect of treatment group was shown in reading age scores when all readers were

Table 12 Post test Means (Adjusted for Pretest and Age) and Significance of Between Group Differences

	N.T.	O.T.	P.E.	F. ratio	df
Handwriting[a]	.64	.73	.68	0.379	2/47
Reading Age	6.51	6.93	6.21	2.22	2/47
Reading Age[b]	7.63	8.37	8.03	5.37*	2/24
Reading Word Test[c]	8.36	11.85	6.62	2.316	2/22
Language (BLST)	115.52	115.19	121.05	2.590	2/49
TPPT*	9.27	8.16	9.23	1.450	2/49
SCSIT					
PS	16.12	16.36	16.74	0.184	2/48
DC	10.41	9.69	10.15	0.348	2/48
GRA	10.37	9.48	8.22	1.501	2/49
IP	11.56	11.5	11.63	0.006	2/49
MACR	142.0	143.24	139.39	1.360	2/48
MACL	136.94	136.26	135.88	1.010	2/48
MAC-Dom	143.91	144.01	139.10	2.836	2/48
MAC-NDom	135.18	135.40	136.30	6.167	2/48
SV	15.9	17.13	17.7	0.614	2/48
FG	16.08	15.66	14.91	0.184	2/48
KIN	61.45	60.15	59.59	0.126	2/48
MFP	7.53	7.14	8.25	1.138	2/49
FI	9.51	9.24	8.06	1.497	2/45
LTS	11.56	11.50	11.63	0.031	2/49
DTS	29.47	29.56	29.98	0.104	2/49
BMC	9.2	7.92	7.72	0.953	2/46
SBO	36.53	45.71	26.13	0.898	2/49
SBC	7.1	11.57	6.36	1.896	2/47
CML	19.72	17.36	17.67	1.006	2/48
CMLX	17.61	16.26	16.38	0.324	2/48
RLD	13.39	12.09	12.32	0.323	2/48
Self Esteen	36.62	37.61	39.52	0.682	2/43
Reading Letter Test	45.23	42.62	45.67	0.294	2/22
Teacher Ratings[a]	24.94	26.03	24.82	0.647	2/42

Note: Scores of Ss 01 and 04 are excluded except for parent and teacher questionnaire data.

[a] On these measures 0 is the highest score.

[b] Ss reading beyond the emergent level at pretest only.

[c] Emergent readers only.

* $p = .01$

considered together, by the analysis of covariance ($F = 2.27$, df 2/47).

Table 13 Improvement in Reading Ability of Readers Emergent at Pretest

Group	n	Reading Improvement	
		No progress	1 to 12 months progress
NT			
Under 6	5	2	3
Over 6	2	1	1
OT			
Under 6	3	1	2
Over 6	3	1	2
PE			
Under 6	4	2	2
Over 6	2	1	1

Note: Scores of subjects 01 and 04 are not included.

The results of the analysis of the reading age scores for subjects already reading at pre-test demonstrated a significant effect of treatment group ($F = 5.37$, df 2/24, $p=0.01$). A comparison between the OT and NT groups in adjusted post-test means using a Scheffé test, revealed significant differences between groups ($S = 6.64$, df 2/24, $p<0.01$). A similar comparison between the adjusted means of the OT and PE groups showed a significant difference ($S = 2.12$, df 2/24, $p<0.05$). The OT groups showed significantly greater adjusted posttest means than the PE programme or no treatment. The comparison between the PE and NT groups

(S = 3.65, df 2/24, $p<0.01$) was also significant and favoured the PE group. Table 13 presents reading gain scores divided into two levels of progress for readers at the emergent level. A chi-square test revealed no significant between group differences.

Other Reading Measures. Table 12 shows there were no significant differences between groups on The Basic Word tests (F = 2.315, df 2/22) and letter identification test (F = 0.294, df 2/22). Self correction scores for instructional and hard texts and the six miscue analysis scores are reported in Table 14. In this table, 1 represents a positive difference between post and pretest scores and 0, a negative difference or no change. Chi squared tests indicated that there were no significant differences between groups.

SUMMARY

It is clear from the results of these analyses that, with the exception of the reading scores for those children who were already reading at pretesting, none of the differences between the three groups were statistically significant. This means that, for most of the measures when the children's age and status at the time of pretest are taken into account, the progress of children in the different treatment programmes does not differ significantly.

Table 14 Improvement on Ordinal Scaled Reading Measures

Variable	Improvement[a]	Treatment Group NT	OT	PE	Totals
Self Correction Rate					
Instructional	0	6	4	4	14
	1	3	3	2	8
Hard	0	7	6	3	15
	1	4	3	6	13
Miscue Analysis					
Meaning Maintained	0	2	2	3	7
	1	7	10	8	25
Words Omitted	0	8	6	7	21
	1	1	6	4	11
Use of semantic cues	0	2	3	5	10
	1	6	7	6	19
Use of syntactic cues	0	2	3	7	12
	1	6	7	4	17
Use of graphic cues	0	5	7	7	19
	1	3	3	4	10
Use of phonic cues	0	6	5	7	18
	1	2	5	4	11

Note: Scores of subjects 01 and 04 are not included

[a] A score of zero represents no improvement or poor performance.

A socre of one represents improvement in performance from pre- to posttesting.

3.3 FACTORS AFFECTING PROGRESS AND QUESTIONNAIRE DATA

3.3.1 Variables related to improvement

The heterogeneous nature of the subject group, which was reflected in the wide array of handicapping conditions evidenced by this group at pretesting, suggested that the average result of the OT programme may have obscured significant changes amongst some of the children in the OT group.

The likelihood that some children progressed more than others suggested the possibility of identifying these children and also identifying any characteristics which distinguished them from children who did not benefit from the programme. One way of doing this is to look for any pretest measures which might have been consistently related to progress on the major criterion measures.

To determine which factors might be consistently related to children's progress, multiple regression analyses were performed with each reliable posttest measure as the dependent variable. All of the pretest measures were entered as potentially significant independent variables. The results of the multiple regression analysis indicated that a number of variables were related to each of the criterion measures.

The one variable which was found to be most frequently related to children's progress on the dependent measures was the SCSIT subtest, Double Tactile stimulation (DTS). There were other variables which were suggested by the multiple regressions analysis on a number of dependent variables to be important to children's progress, although they weren't related to children's progress as frequently as DTS. These variables included the variable which noted

the children who had severe epileptic seizures, subjects' SI syndromes, ability to copy from the blackboard, scores on MAC-L and a number of different measures including socio-economic status, which were intercorrelated and probably all reflected extent of socio-cultural deprivation. The epilepsy variable was highly correlated with DTS scores.

The consistent relationship between the DTS scores and the criterion measures for the children in the OT group suggested that the DTS scores may have measured or been related to some aspect of the children's neurophysiological functioning which affected their capacity to benefit from SIT. In order to test out this possibility, the results for the three groups were re-analysed using analysis of covariance with the DTS scores entered alongside the pretest scores as a covariate.

The effect of this procedure was to identify a significant difference between the three groups on the MAC-Dom and the reading age measure for the whole group, as well as the reading age measure for those who were already reading at pretest.

Table 15 presents posttest means of reliable measures, adjusted for age and DTS score. Results showed a significant effect of treatment group on the reading age measure with all readers ($F = 3.25$, df 2/47, $p<0.05$). Comparisons between the OT and NT groups using the Scheffé test showed significant differences in adjusted posttest scores ($S = 5.2$, df 2/47, $p<0.01$). The OT group adjusted posttest mean was 6.90 compared to the NT group means which was 6.51. The comparison between the PE and NT group was also significant ($S = 3.2$, df 2/47, $p<0.01$), but the same comparison between the OT and

Table 15 Post Test Means (adjusted for Pretest and DTS) and Significance of Between Group Differences for Reliable Measures Only

Variable	Treatment Group NT	OT	PE	MS_W	F ratio	df
Handwriting [a]	0.67	0.70	0.67	0.08	0.08	2/47
Reading Age	6.51	6.90	6.75	0.20	3.25*	2/47
Reading Age [b]	7.62	8.40	8.02	0.23	5.60**	2/24
Reading Word Test	8.73	10.51	8.28	17.14	6.56	2/21
Language	115.99	114.49	121.28	73.32	2.78	2/49
Teacher and Parent Problem Totals [a]	9.06	8.08	8.57	3.67	1.12	2/48
SCSIT						
P.S.	16.08	16.67	16.43	9.19	0.16	2/48
D.C.	10.43	9.76	10.04	7.07	0.27	2/48
GRA	8.22	9.73	10.13	12.72	1.29	2/49
I.P.	11.38	11.96	11.49	9.88	0.23	2/49
MAC-Dom	143.36	144.41	139.07	37.63	3.22*	2/48
MAC-NDom	134.94	135.69	136.25	32.95	0.20	2/48

Note: Scores of subjects 01 and 04 are not included in all measures except TPPT.

a. On these measures 0 is the highest possible score.

b. Only scores of subjects already reading at pretest are included.

* $p<.05$

** $p=.01$

PE groups failed to show a significant difference. The PE group adjusted posttest mean, which was 8.02, was between the OT and NT adjusted posttest means.

There was also a significant treatment group effect on the reading age measure when only those subjects who were reading at pretest were considered on the analysis of covariance ($F = 5.6$, df 2/24, $p = 0.01$). The adjusted posttest means for the OT, PE and NT groups were 8.40, 8.02 and 7.62 respectively. A series of comparisons between the groups, using the Scheffé test, showed the difference in adjusted means of the OT and NT groups ($S = 7.64$, df 2/24, $p<0.01$), the OT and the PE groups ($S = 3.05$, df 2/24, $p<0.05$) and the PE and NT groups ($S = 3.71$, df 2/24, $p<0.01$), all to be significant.

On the reading measure the use of DTS as a covariate resulted in a significant treatment group effect for reading scores when all subjects were considered, not just children already reading at pretest. It also adjusted the PE group mean so that it was above the NT group mean.

Results of the Motor-Accuracy Dominant scores demonstrated a significant effect of treatment group ($F = 3.22$, df 2/48, $p<0.05$). A comparison between the adjusted posttest means of the OT and PE groups showed that the differences between the groups were significant ($S = 5.03$, df 2/48, $p<0.01$). A comparison between the NT and PE groups demonstrated a significant difference favouring the NT group ($S = 4.04$, df 2/48, $p<0.01$). No significant difference was found between the adjusted posttest means of the OT and NT groups however.

On the MAC-Dom it appears that the use of the DTS

scores as a covariate, differentiated between the OT and PE groups, but did not show any difference between the OT and NT groups.

In essence, what these covariate correlation has done to MAC-Dom scores, is to raise the adjusted means of the OT group to a level above the PE group and about the same as the level of the NT group. This correction occurs because the OT group were relatively low on many of the SCSIT pretest measures. Since they started lower, the progress they did make appears greater when statistical corrections are made for the initial deficit. However, the correction is not sufficient to show that they progressed above the NT group.

3.3.2 Children Suited to Therapy: A Third Method of Analysis

An important practical question related to which factors appear to be most important to children's progress, is which are are chilren who were most likely to benefit from the OT programme. This represented a second approach to the problem of the wide variation of response to treatment of the children in the OT programme.

An answer to this question was sought by identifying these individual children who failed to make progress in the OT programme and by looking for the characteristics which differentiated them from the children who did make progress.

This was done by using the residual scores calculated for each child during the multiple regression analyses referred to in the previous section. These residual scores

represented that portion of the child's score on a specific criterion measure which could not be accounted for by the child's pretest or other predictor measures used. An examination of the residual scores indicated that certain subjects consistently made less than expected progress. Six children were identified who had standardised residual scores of one standard deviation or more below the expected mean on at least three of the 14 reliable criterion measures.

An examination of these subjects' pretest scores showed that they had extreme scores on the variables which had been indicated to be important to progress in the multiple regression analyses: it was found that these children had very low scores on the DTS or were epileptic or were socio-culturally deprived or had certain areas of dysfunction (noted by the OT's). The variable socio-cultural deprivation was noted positive if a mother was the solo parent and her sole source of income was the Domestic Purposes Benefit. An examination of the areas of dysfunction indicated that all the children in the OT group who had severe behaviour problems noted by the OTs as one of the three main areas of dysfunction, were also indicated as making less than expected progress in the analysis of residual scores.

The three children who were epileptic all had low DTS scores at pretesting. The criterion of epilepsy therefore replicates that of low DTS scores, except that in one case, where the child's epilepsy became evident following pretesting. This child's pretest DTS score was slightly above the criterion score on DTS.

Table 16 Number of subjects unsuited to SIT therapy in each group and causes of unsuitability

Cause of Unsuitability	Treatment Group NT	OT	PE
low score on DTS (17) or epileptic		3[a](2)	2[b](1)
socio-culturally deprivation is predominant	1[a](1)	1[a](1)	2 (1)
severe behavioural problems predominant	(1)	2 (3)	1
si problems insufficient to warrant treatment	1	1	1
Totals	2	7	6

a. These children have severe behavioural problems in addition to noted difficulty. Number in brackets represents N of subjects.

b. These children socio-culturally deprived in addition to noted difficulty. Number in brackets represents N of subjects.

If those subjects with Double Tactile Stimulation raw scores of below 17, or those noted as having epilepsy, or recorded as having severe behavioural problems, or those noted as socio-culturally deprived, five of the six OT group subjects who consistently did not progress are encompassed. The application of these criteria to the total group of subjects resulted in the exclusion of 12 subjects. Added to this total are the three subjects who, following clinical observations and examination of SCSIT scores, were considered by the occupational therapists to have insufficient SI problems to warrant treatment.

Table 16 shows the number of subjects in each group who were suggested by this analysis to be unsuited to therapy. A number of children were unsuited for therapy for more than one reason. The remaining subjects are those children who were suited to therapy.

Results of Third Method of Analysis

Table 17 presents the posttest means (adjusted for pretest and age) and significance of between group differences, found using analyses of covariance, for only subjects suited to therapy. Results demonstrated that there were significant effects of treatment group in three analyses

The results of these analyses were very similar to the results of the second method of analysis which adjusted for subjects initial score on the DTS. The only difference in the findings of these two methods of analysis was a greater difference, in the third method of analysis, between the PE and OT groups adjusted posttest means on the reading measure, with all subjects considered.

Table 17 Post test means (adjusted for Pretest and Age) and Significance of Between Group Differences for Subjects suited to therapy only

Variable	Treatment Group NT	OT	PE	MS_W	F ratio	df
Handwriting[a]	0.63	0.73	0.62	0.07	0.63	2/33
Reading Age	6.32	6.88	6.52	0.19	4.78*	2/33
Reading Age[b]	7.27	8.16	7.64	0.20	7.40**	2/17
Reading Word Test	8.86	10.16	7.68	15.88	0.22	2/14
Language	116.71	115.77	121.02	64.76	1.24	2/34
Teacher and Parent Problem Totals[a]	9.23	8.43	8.69	3.5	0.58	2/32
SCSIT -						
P.S.	16.29	17.24	17.27	10.1	0.32	2/33
D.C.	10.18	11.16	9.03	8.75	1.29	2/33
GRA	9.96	9.83	7.67	13.79	1.26	2/34
I.P.	11.62	12.90	11.59	9.85	0.65	2/34
MAC-Dom	143.29	145.92	137.07	40.44	4.66*	2/33
MAC-NDom	135.77	136.62	137.07	32.06	0.17	2/33

Note: The scores of subjects 48 and 56 are excluded because these Subjects experienced programmes similar to OT.

a. On these measures zero is the highest possible score.

b. Only measures of subjects already reading at pretest are included.

* $p<.05$

** $p<.01$

Results of the reading age scores indicated a significant effect of treatment group ($F = 4.78$, df 2/33, $p<0.02$). A comparison of the differences in the adjusted posttest means indicated that the OT group mean was significantly greater than both the NT group mean ($S = 6.67$, df 2/31, $p<0.01$) and the PE group mean ($S = 3.56$, df 2/31, $p<0.01$). The comparison of the PE and NT adjusted posttest means showed a significant difference which favoured the PE group ($S = 3.22$, df 2/31, $p<0.05$).

The results of the reading age scores for STT subjects when only those subjects who were reading at pretest are selected, indicated a significant effect of treatment group ($F = 7.40$, df 3/17, $p<0.01$). A comparison between the adjusted posttest means of the OT and PE groups demonstrated a significant difference favouring the OT group ($S = 3.67$, df 2/17, $p<0.01$). A comparison between the adjusted posttest means of the OT and NT groups indicated a significantly greater OT group mean ($S = 7.94$, df 2/17, $p<0.01$). The differences in adjusted posttest means between the PE and NT groups, were also significant ($S = 3.09$, df 2/17, $p<0.05$), and favoured the PE group.

The results of the Motor Accuracy - Dominant scores show a significant effect of treatment group ($F = 3.22$, df 2/45, $p<0.05$). A comparison between the adjusted post-test means of the OT group and the PE group using the Scheffé test demonstrated a significant difference favouring the OT group ($S = 6.52$, df 2/33, $p<0.01$). A comparison in the adjusted posttest means of the NT and PE groups indicated that the NT group mean was significantly greater ($S = 4.79$, df 2/33, $p<0.01$). A similar comparison between the OT and

the NT groups failed to demonstrate a significant difference between groups on this measure.

Table 18 presents the means and standard deviations of the gain in reading and fine motor development for children suited and unsuited to therapy. An examination of this table shows that the mean gain in reading and MAC-Dom in the OT group children was greater for those children who selected as suited to therapy than those selected as unsuited for therapy. However, the mean gain in reading for the PE group was greater in those children unsuited to therapy. This is explained by the nature of the children excluded in the PE group. There were only two children excluded on the NT group. The progress of the children unsuited to therapy in the NT group is, therefore, not compared with the progress of these children in the other two groups.

Table 19 presents the percent of children making reading progress among those suited and unsuited for therapy. The children unsuited in the PE group were all in the group who were already reading at pretest, whilst those excluded in the OT group were all non-readers except one. The children who were already reading at pretest progressed on average more than the non-readers. This meant that the exclusion of children in the PE group reduced the overall level of performance. Of the unsuited children in the PE group who made good progress in reading, one child was excluded because he was considered to have insufficient SI problems to warrant treatment, two children were excluded because they came from socio-culturally deprived backgrounds and one because he showed behavioural difficulties. This

Table 18 Means and Standard Deviations of Gain in Reading and Fine Motor Development for Children Suited and Unsuited to Therapy

Group	N	Reading Gain $\bar{X}$	Reading Gain SD	MAC-Dom Gain $\bar{X}$	MAC-Dom Gain SD
Suited to Therapy					
Total group	38	0.60	0.62	2.34	8.19
NT	17	0.51	0.53	3.38	7.00
OT	12	0.90	0.81	6.25	6.45
PE	9	0.39	0.28	-4.00	8.71
Unsuited to Therapy					
Total group	14	0.82	0.71	0.133	5.71
NT	2	1.25	0.35	0.50	7.78
OT	6	0.47	0.80	0.43	7.66
PE	6	1.03	0.61	-0.33	2.88

Table 19 Percent of children making more reading progress to those making less progress, in children suited and unsuited for therapy

	Emergent readers[a]		Advanced readers[b]	
	Percent progressing	Number in group	Percent progressing	Number in group
NT				
Suited	57	7	50	10
Unsuited	-	-	100	2
OT				
Suited	67	6	83	6
Unsuited	75	4	100	1
PE				
Suited	60	5	75	4
Unsuited	-	1	100	5
All groups				
Suited	61	18	65	20
Unsuited	60	5	100	8

[a] Emergent readers were those children with pretest reading age scores of less than 5.3. For these readers progress was defined as any positive change at all.

[b] Advanced readers were those children with pretest reading age scores of 5.3 or above. For these readers progress was defined as 6 months or more.

suggests the possibility that the PE programme helped different sorts of children to those helped in the OT programme.

3.3.3 Other Factors Affecting Results

Involvement with Other Agencies

Table 20 presents frequency data on the involvement of subjects with other agencies between pre and posttesting. More children in the OT group attended SPELD and Ward 24. The mean gain of those children who attended SPELD and Ward 24 and the total group is presented in Table 21. There were no differences in mean gain between groups.

Number of Treatment Sessions and Home Programmes

The parents' stated frequency of use of home programmes was not correlated with improvement for the OT and PE groups. Figures 1 and 2 present the children's gain scores in reading and MAC-Dom, compared to the number of treatment sessions they attended. For the PE group there appears to be a tendency for thosechildren who attended more sessions to have improved less. However, the gain in both MAC-Dom on reading increases with number of treatment sessions for the OT group.

3.3.4 Questionnaire Data

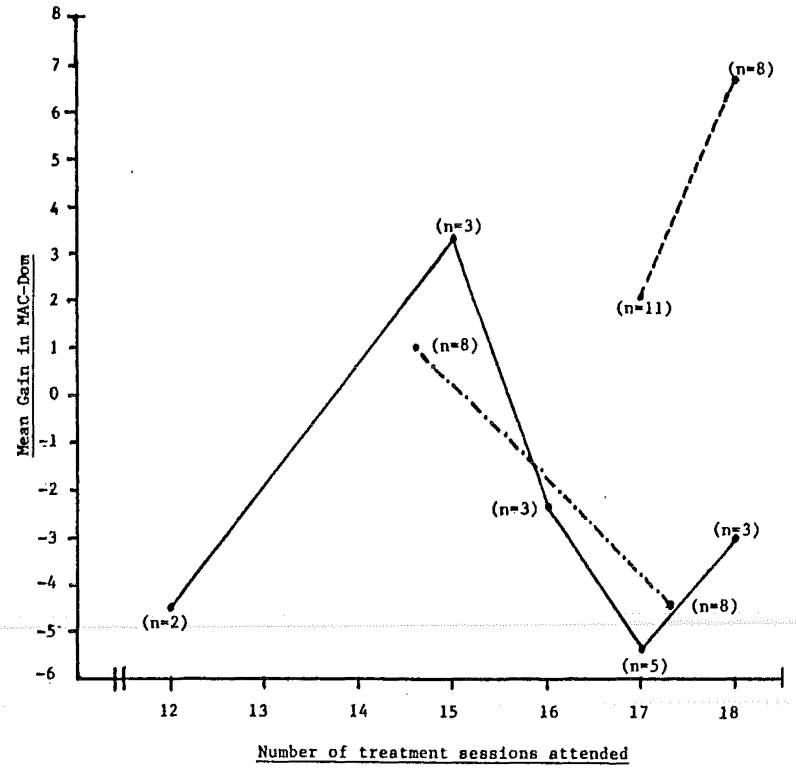
At pretesting and posttesting all the parent questionnaires were returned. At pretesting all teacher questionnaires were returned, although one was incomplete. At posttesting one teacher questionnaire was not returned and one questionnaire was incomplete.

Table 20 Frequency of involvement with other agencies between pre and posttesting

	Type of Agency: Speech Therapy	Reading Help	Child and Family Guidance	School Psychologist	SPELD	Health Camp	Ward 24	Sensory Motor other than OT	Optometrist or Medical specialist	Special Class	Small group at school	Other	Total	$\bar{X}$
NT N = 19	8	5	0	4	2	0	0	1	4	2	1	3	30	1.58
OT N = 19	4	4	4	4	4	0	2	0	8	3	3	6	42	2.21
PE N = 16	5	6	1	5	0	0	0	1	4	0	0	6	28	1.75
Total N = 54	17	15	5	13	6	0	2	2	16	5	4	15	100	1.85

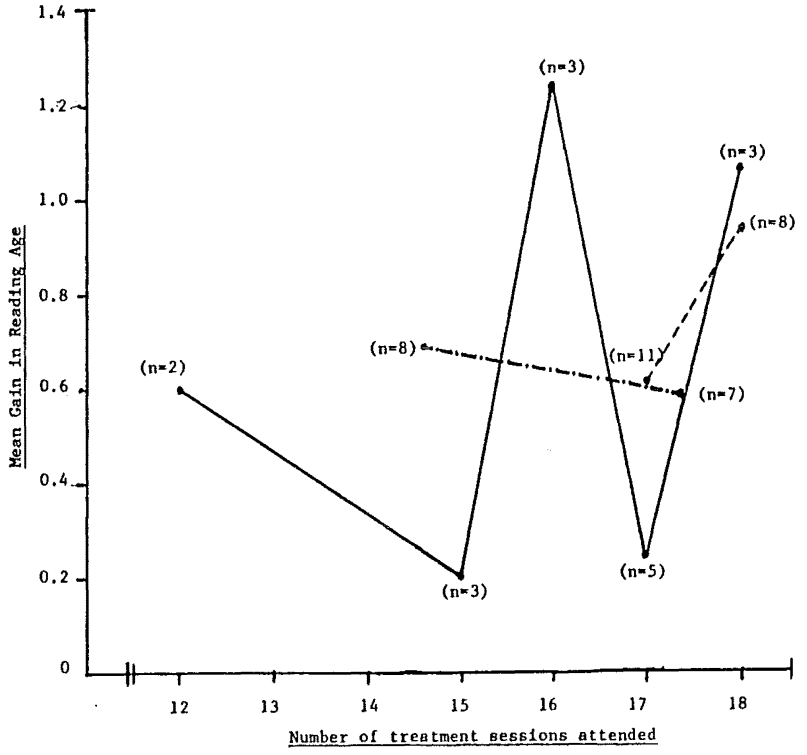
Table 21 Means and Standard Deviations of gain in reading and fine motor development for children who attended SPELD and Ward 24, and for the total group

Group	N	Reading $\bar{X}$	Reading SD	MAC-Dom $\bar{X}$	MAC-Dom SD
Ss attended SPELD	6	0.31	0.18	1.33	9.14
Ss attended Ward 24	2	0.15	0.21	7.00	11.31
Total Group	52	0.66	0.64	1.72	7.58



Key:
OT group
PE group
PE group gain averaged for high and low attendance

Figure 1. Mean Gain in MAC-Dom Scores for OT and PE group Children Compared to the Number of Treatment Sessions Attended.



Key:
OT group
PE group
PE group gain averaged for high and low attendance

Figure 2. Mean Gain in Reading Age Scores for OT and PE group Children compared to the Number of Treatment Sessions Attended.

The teacher and parent questionnaire data is presented in more detail in Tables 22 to 27. The correlations between the pretest and posttest scores obtained from the questionnaire was not high (0.51), suggesting that they may have been somewhat unreliable. Differences between means must therefore be interpreted with caution. However, there may also have been genuine changes in the teachers and parents perception of the children's problems. These results also represent the judgements of those people whose concern in many cases prompted the referrals and they allow the reader to determine to what extent the children in the study were disabled in areas of learning.

Table 22 shows the number of children who were rated 4 or 5, that is 'poor' or 'very poor', on school subjects at pre and posttesting. Assuming a rating of 4 or 5 is an indication that a child is having difficulty with a subject, then these results suggest that children tended to have learning difficulties with more than one subject. The most frequently reported areas of difficulty were handwriting and written language. There was a decrease in the number of children rated as having learning difficulties between pretesting and posttesting. This decrease was larger for the NT and PE groups than it was for the OT groups.

Table 23 presents the means and standard deviations of the teacher ratings of subject areas on five point scales. The mean rating for all subjects was slightly below average. There seems to be little consistent change between pre and posttesting in these ratings except in physical education where all 3 groups improved. The

Table 22 Number of children rated 4 or 5 on subject areas by teachers at pre and posttesting

Group	N	Reading	Spelling[a]	Hand Writing	Maths	P.E.	Written Language	Speech
NT								
pretest	19	14	10	16	13	11	18	14
posttest	18	7	9	13	6	10	15	11
OT								
pretest	18	11	10	15	12	16	15	13
posttest	18	11	10	13	11	12	13	11
PE								
pretest	18	10	12	12	10	14	16	12
posttest	16	8	9	9	8	8	9	6

[a] The total number of children rated for spelling is less than for other subjects. At pretest the total was 40 and at posttest it was 46.

Table 23 Means and standard deviations (SDs) of teacher ratings of subject areas Subject area. (Scale: 1 = excellent, 5 = very poor)

Group	Testing	Reading $\bar{X}$	Reading SD	Spelling $\bar{X}$	Spelling SD	Hand-writing $\bar{X}$	Hand-writing SD	Maths $\bar{X}$	Maths SD	Phys-ed $\bar{X}$	Phys-ed SD	Written Lang. $\bar{X}$	Written Lang. SD	Speech $\bar{X}$	Speech SD	All Subjects $\bar{X}$	All Subjects SD
NT	Pre	3.74	0.93	2.53	2.04	4.26	0.73	3.79	0.63	3.95	0.91	4.21	0.53	4.05	0.77	26.53	3.03
	Post	3.33	0.76	3.68	0.87	3.72	1.93	3.33	0.84	3.44	1.15	4.00	0.59	3.78	0.73	24.88	4.48
OT	Pre	3.37	1.34	3.21	2.02	4.11	0.74	3.63	1.42	4.00	1.15	4.16	1.26	3.84	1.07	26.00	5.48
	Post	3.56	1.04	3.82	1.33	3.94	0.87	3.82	1.19	3.78	0.65	4.00	0.90	3.56	0.78	26.00	4.57
PE	Pre	3.88	0.86	3.29	1.96	3.82	1.33	3.76	0.75	4.00	0.61	4.24	0.56	3.71	0.85	26.88	3.78
	Post	3.38	0.89	3.77	0.83	3.56	0.72	3.44	0.96	3.56	0.81	3.63	0.96	3.88	0.86	24.33	3.14

totalled ratings of the NT and PE groups improved slightly whilst those of the OT group remained the same.

Table 24 shows the mean number of subject areas and behaviours that teachers considered had improved between pretest and posttest. The PE group showed a greater mean number of improved subject areas and behaviours than the other two groups. Closer examination of this data revealed that the biggest difference between groups was in the subject area of physical education, in which the PE group was noted more frequently as improved.

Table 24 Mean and standard deviations of number of subjects areas and behaviours that teachers considered had improved from pretesting to posttesting

Group	Number of improved subjects and behaviours	
	$\bar{X}$	SD
NT	2.17	1.54
OT	2.22	1.26
PE	3.00	1.37

Table 25 presents the means and standard deviation of the teacher ratings of classroom behaviours. With the exception of submissive and attention-seeking behaviours, the frequency of these behaviours appears to have decreased from pre to posttesting. The decrease in aggressive behaviours and difficulty copying from the blackboard appears to be largest for the OT group.

Table 26 shows the means and standard deviations of teacher and parent-noted problems, which were derived from the open-ended questions about problem areas and difficult

Table 25 Means and standard deviations (SDs) of teacher ratings of behaviour traits

Behaviour (Scale: 0 = never occurs; 1 = rarely occurs; 2 = often occurs; 3 = very frequently occurs)

Group	Testing	Aggressive $\bar{X}$	Aggressive SD	Submissive $\bar{X}$	Submissive SD	Lacking Confidence $\bar{X}$	Lacking Confidence SD	Withdrawn $\bar{X}$	Withdrawn SD	Poor socially $\bar{X}$	Poor socially SD	Attention seeking $\bar{X}$	Attention seeking SD	Over-Active $\bar{X}$	Over-Active SD	Distractable $\bar{X}$	Distractable SD	Difficulty copying from B.B. $\bar{X}$	Difficulty copying from B.B. SD	Total Behaviour $\bar{X}$	Total Behaviour SD
NT	Pre	1.05	0.85	1.26	0.80	1.84	0.60	1.74	0.81	1.21	0.79	1.37	1.01	1.84	1.21	2.26	0.73	2.26	1.05	14.84	3.91
	Post	1.11	0.67	1.39	0.85	1.50	0.70	1.56	0.78	1.05	0.73	1.28	0.89	1.67	0.84	2.00	0.91	2.06	1.00	13.61	4.55
OT	Pre	1.56	1.07	1.26	1.05	1.68	0.82	1.53	1.02	1.00	0.81	1.68	0.95	1.84	1.01	2.42	0.84	2.47	0.77	15.05	4.74
	Post	0.89	0.83	1.44	0.78	1.53	0.70	1.12	0.93	0.89	0.73	1.83	0.92	1.50	0.79	2.00	0.77	1.78	0.88	13.00	3.77
PE	Pre	1.00	0.71	1.24	0.97	1.71	0.85	1.47	0.80	1.29	0.68	1.23	0.83	2.06	0.83	2.41	0.80	2.18	1.24	14.59	4.18
	Post	1.38	0.62	1.25	0.86	1.69	0.60	1.19	0.66	1.18	0.75	1.44	0.63	1.81	0.98	2.06	1.00	1.75	0.86	13.75	3.21

Table 26 Means and Standard Deviations (SDs) of Teacher and Parent-noted Problems

Problem Areas (Scale: noted as problem, 1; not noted, 0)

Treatment Group		Learning (Teacher only) $\bar{X}$	Learning (Teacher only) SD	Co-ordination $\bar{X}$	Co-ordination SD	Problem Speech $\bar{X}$	Problem Speech SD	Copying blackboard (Teacher only) $\bar{X}$	Copying blackboard (Teacher only) SD	Concentration $\bar{X}$	Concentration SD	Social and Behavioural $\bar{X}$	Social and Behavioural SD
NT	Pre	1.00	0.00	1.00	0.00	0.95	0.23	0.53	0.51	0.79	0.42	0.95	0.23
	Post	0.89	0.31	0.84	0.37	0.90	0.32	0.47	0.51	1.00	0.00	0.89	0.32
OT	Pre	0.94	0.22	1.00	0.00	0.79	0.42	0.53	0.51	0.95	0.23	0.89	0.32
	Post	0.84	0.37	0.84	0.37	0.68	0.47	0.31	0.48	0.95	0.23	0.74	0.45
PE	Pre	1.00	0.00	0.94	0.00	0.94	0.24	0.35	0.49	0.88	0.33	0.82	0.39
	Post	0.88	0.33	0.71	0.47	0.71	0.47	0.24	0.44	0.88	0.33	0.88	0.33

Table 27 Means and Standard Deviations (SDs) of Parent-noted Frequency of Behaviours at Pre and Post-testing (Scale: often 2, sometimes 1, never 0)

Treatment Group		Poor at Sport		Clumsy		Aggressive		Over-Active		With-drawn		Poor Sleep		Anxious		Attention Seeking		Distractable		Unable to dress self etc.		All Behaviours	
		$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD	$\bar{X}$	SD
NT	Pre	1.53	0.84	1.16	1.01	0.68	0.95	1.68	0.67	0.84	0.96	0.37	0.76	0.74	0.93	1.37	0.96	1.05	1.03	0.32	0.75	9.74	2.68
	Post	1.37	0.96	0.89	0.99	0.63	0.89	1.26	0.99	0.73	0.93	0.21	0.63	0.90	0.99	0.84	1.01	1.47	0.84	0.05	0.23	8.37	3.17
OT	Pre	1.68	0.67	1.26	0.87	0.68	0.95	1.47	0.84	0.68	0.96	0.42	0.77	1.11	0.86	1.26	0.93	1.63	0.76	0.26	0.65	10.47	2.27
	Post	1.21	0.91	0.95	0.97	0.83	0.92	1.47	0.84	0.53	0.84	0.26	0.56	1.95	1.03	1.42	0.90	0.89	0.96	0.53	0.90	8.82	2.71
PE	Pre	1.35	0.36	1.24	0.97	0.94	0.97	1.23	0.97	0.82	0.95	0.47	0.87	1.35	0.93	1.29	0.98	1.41	0.94	0.47	0.87	10.59	4.17
	Post	1,99	9,96	1.00	0.96	0.81	0.91	1.50	0.89	0.75	1.00	0.50	0.89	1.13	0.88	1.13	1.02	0.75	1.00	0.44	0.81	9.00	4.55

behaviours in both questionnaires. Learning, co-ordination and concentration problems were the most frequently noted problems. Except for concentration and social and behaviour problems, problem areas show an improvement from pre to posttesting in all groups. The number of children evidencing difficulties copying from the blackboard again seems to have decreased most for the OT group.

Table 27 presents the means and standard deviations of parent ratings of behaviours. For the totalled behaviours all groups show a slight decrease between pre and posttesting. The inconsistent trends in the individual behaviours probably reflects the unreliability of these ratings.

Summary of Questionnaire Data

These results suggested that a large number of children in the study could be considered learning disabled at pretesting, according to their teachers' perceptions. These results also suggested that the OT group children made less progress than the other two groups in school subjects, as rated by their teachers. Frequency of aggressive behaviours and difficulties copying from the blackboard may have decreased more for the OT group than for the other two groups.

CHAPTER 4

DISCUSSION

4.0 INTRODUCTION

The results obtained in this study will be discussed in four parts. In the first section results of the study are summarised. The second section interprets these findings. In the third section the question of which subjects appear to be best suited to SIT is examined. Limitations of the present study and recommendations for future research are included in the fourth section, and the chapter concludes with a summary.

4.1 SUMMARY OF RESULTS

The results of the present study do not provide a simple answer to the question of whether SIT at Christchurch Hospital improves children's clumsiness and learning disabilities. The differences between the groups on reliable measures were examined in three different analyses of covariance.

First Method of Analysis

In the first of these comparisons between groups all subjects were considered and an attempt was made to reduce the effects of differences on pretest scores and age by entering them as covariates.

OT Programme. These comparisons of the three groups indicated that the Occupational Therapy programme resulted in no greater gains in language development, perceptual-motor development or handwriting, than the PE programme or than no treatment. The OT treatment was related to improvement in the reading of children who were already reading at pretest, but was not related to improvement in the reading of children who were emergent at pretest when compared to no treatment or treatment with the PE programme.

PE Programme. The PE programme resulted in significantly greater gains than the control group, in reading for children already reading at pretest.

Other Measures. The scores from the Culture Free Self Esteem Inventory were found to be too unreliable to assess the affect of the OT programme on the children's self-esteem.

The information from Questionnaires administered to teachers and parents suggested that the OT group made less improvement in school subjects according to teacher ratings. The ability to copy from the blackboard may have increased more for the OT group than for the other two groups and the frequency of aggressive behaviours may have decreased more for this group.

Factors Related to the Effectiveness of Treatment

Multiple regression analysis was used as an exploratory technique to try to identify any factors which might have been related to the relative effectiveness of the treatment with different children. One factor did appear to be consistently related to the effectiveness of the treatment

on several different outcome measures. This was the measure of Double Tactile Stimulation.

Second Method of Analysis

OT Programme. When the measure of DTS was added as a covariate in addition to pretest scores, the results indicated that the OT programme produced significantly greater gains in reading for all children (not just those who were reading at pretest) when compared with no treatment. Compared to the PE programme, results indicated that the OT programme produced significantly greater gains in fine motor development as well as reading development for those children already reading at pretest.

PE Programme. The PE programme resulted in significantly greater gains in reading development than no treatment, but the no treatment group performed significantly better on the measure of fine motor skills than the PE group.

These results suggest that the effectiveness of the OT programme is related in some way to the child's ability to respond to DTS.

Third Method of Analysis

A third method of analysis was based on the possibility that only some of the children included in the study were in fact suited to the therapy. This seemed likely because of the heterogeneity of the subject group and the differences between subjects in their response to therapy. An attempt was made to identify those children who did best in the OT treatment. This was done by examining the residual scores

from the multiple regression analysis and determining criteria for inclusion.

The results of these procedures suggested that 12 children who had low DTS scores, or epilepsy, or behavioural problems or were socio-culturally deprived, were unsuited to therapy. The children who were unsuited to therapy were unevenly distributed between the three groups, with the PE and OT groups containing fewer suited children than the control group. The greater attendance of OT group subjects at other remedial agencies before treatment and the tendency of the OT group to score lower at pretest than the other two groups on the motor tests of the SCSIT, possibly reflects these inequalities.

OT Programme. When only those subjects who were suited to therapy were considered, the OT programme produced significantly greater gains in reading development for all readers than both the no treatment or the PE programme. On the measure of fine motor skills, when only those subjects suited to therapy are considered, the OT group improved significantly more than the PE group, but not the NT group.

PE Programme. The PE programme produced significantly greater gains in reading development than receiving no treatment, but the no treatment group performed significantly better on the measure of fine motor skills than the PE group.

The Three Analyses Together

These three comparisons yield consistent results when viewed together. Table 28 summarises the comparisons between

Table 28 Summary of Significance of Comparisons Between Groups[b]

Type of analysis	Groups Compared		
	OT with NT	OT with PE	PE with NT
1. Pretest and age as covariates			
Reading - All Subjects[a]	+	+	0
- Readers only	+	+	+
MAC-Dom[a]	0	+	-
2. Pretest and DTS as covariates			
Reading - All Subjects	+	0	+
- Readers only	+	+	+
MAC-Dom	0	+	-
3. Subjects suited to therapy only			
Reading - All Subjects	+	+	+
- Readers only	+	+	+
MAC-Dom	0	+	-

Note: + represents a comparison between means which was significant at the .05 level or more, and which favoured the first group in the comparison.

0 represents no significant differences between groups.

- represents a comparison between means which was significant at the .05 level or more, and which favoured the second group in the comparison.

[a] The overall effect of treatment was not significant at the .05 level for these comparisons as shown using analysis of covariance.

[b] All comparisons in the means between groups were made using the Scheffé method.

groups for the three methods of analysis. The OT programme produced significantly better performance than the PE programme in both reading and fine motor skills, except in one analysis where there was no significant difference between groups. The OT programme produced significantly better performance than no treatment in reading but not fine motor skills.

The comparisons between the PE and the NT groups showed that the PE programme produced significantly better performance than no treatment on reading, except in one comparison where there was no significant difference. The NT group performed better than the PE group in fine motor skills.

Effect of Attendance at Other Agencies, Length of Treatment and Home Programmes

There were two agencies which offered an intervention similar in some respects to the OT treatment and which more children in the OT group attended than children in the NT or PE groups. However, children who attended SPELD and Ward 24 performed no better than the children who did not attend these agencies, on measures of fine motor skills and reading.

There was no relationship evident between parents' reported use of home programmes and the effectiveness of either the OT or the PE programme. A comparison between the number of treatment sessions attended, and the gain in the fine motor development and reading suggested that for the OT group the number of treatment sessions attended was positively related to gain. For the PE group the results suggested that, particularly in fine motor development, number of

treatment sessions was negatively related to gain: children who attended more sessions had lower scores on MAC-Dom.

4.2 INTERPRETATION OF RESULTS

4.2.1 Fine Motor Skills

OT Group. The MAC-Dom scores show that the OT and NT group means increased about the same amount between pre and posttesting. The lack of significance between scores of the OT and NT groups may be explained by the initial differences between the two groups. The OT group contained subjects who were less likely to improve than the NT group (which suggests that had they not received treatment they may have progressed at a rate significnatly less than the NT group). This is supported by the difference in numbers in the two groups who were unsuited to therapy, and by the differences at pretest between the OT and NT groups on a number of SCSIT subtests.

However, according to this hypothesis, once those subjects who were unsuited to therapy were removed from the analysis, differences between the OT and NT groups should emerge. Although the two group means do diverge, the difference between them, with only children suited to therapy included, is not significant. Moreover, the handwriting error ratio also measured fine-motor control (although it probably has a greater visual-perceptual component than the MAC-Dom). No significant group differences were found on the handwriting measure.

The lack of significant difference between the OT and NT groups therefore suggests that the OT programme did not have a significant effect on fine motor development.

PE Group. The MAC-Dom scores show that the OT group mean increased, whilst the PE group means decreased, between pre and posttesting. The significant differences between scores of the OT and PE groups may be explained by the different emphasis on remediation of fine motor skill deficits in the two programmes. The PE programme focused almost entirely on gross motor skills and very few exercises were included which had a fine motor skill input, whereas an activitiy involving fine motor skills was included in most OT sessions.

However, the lack of significant differences between the means of the OT and NT groups suggests that the differences between the means of the OT and the PE groups was caused by the poorer than expected preformance of the PE group, rather than better than expected performance of the OT group. This decrease of the PE group means between pre and posttesting may be partially the result of unreliability. However, the correlations of MAC-Dom scores between pre and posttesting for the PE group was 0.83. This suggests that poor reliability alone can not account for the mean decrease in scores and that there might be some other, undetermined explanation for these results.

All Groups. There are two other explanations of these results which warrant discussion. The first is that these results were due to the effects of regression towards the mean on the parts of the OT and PE groups, whose scores differed on the MAC-Dom at pretesting. This implies that the OT and PE programmes did not have any effect on fine motor skills.

The second explanation is that the MAC-Dom, while sensitive enough to measure changes over this period, was not sufficiently sensitive to changes resulting from the programmes, and therefore didn't register differences in growth between groups. A number of authors have commented on the difficulty of adequately measuring motor skills (e.g. Bochner, 1980; Jenkins and Sells, 1984): the latter authors found significant effects on one measure of gross motor skills and not another. The most likely explanation of these results therefore, is a combination of the MAC-Dom's lack of validity and unreliability.

4.2.2 Other Perceptual-Motor Skills

The non-significant findings in relation to other perceptual-motor skills may either be because of the difficulties, mentioned above, in measuring motor development, or it may be because the OT programme did not affect these skills.

The majority of SCSIT tests are of questionable reliability and validity. If reliable tests only are considered, perceptual-motor development is not well sampled by the SCSIT. There are no reliable measures of somatosensory perception and only one reliable measure of gross motor development (Imitation of Postures) which measures a small subset of gross motor skills. Visual-motor and fine motor skills are the only areas that can be considered adequately sampled.

This study, therefore, cannot provide a definite answer on whether the OT programme improves children's clumsiness, since it is not clear whether the lack of significant differences is caused by the ineffectiveness of the

OT programme or the unreliability and lack of validity of the tests employed to measure perceptual-motor development.

These findings are congruent with the findings of earlier research. Very few studies, and then generally those with many methodological weaknesses, have found that results on all measures favoured SIT. Instead, research has tended to find inconsistent effects across variables. Moreover, sensory-motor measures are the measures, which have been found overall, to be least likely to show a significant treatment group effect (Myers and Hammill, 1976).

4.2.3 Reading

Although the teachers' ratings of children's reading suggests that the reading performance of the children in the OT group deteriorates between pre and posttesting, a likely explanation for this is the lower reliability of the questionnaire measures compared with the reading measures. There are a number of possible explanations for the significant effect of the OT programme on reading.

Sensory integration. Firstly Ayres (1972) stressed the importance of sensory integration as the basis for the development of more complex cognitive skills, such as reading. SIT aims to improve the brain's basic ability to process and organise sensory information from the environment: an ability important for reading. Ayres (1972) stated, for example:

> Some type of sensory integration, which occurs in the brain stem appears to be critical to the reading process. (p.77)

Eye-muscle movement. An alternative explanation, or perhaps an explanation that operates concomitantly with the above, involves the relationship between reading and eye-muscle movements and the effect of SIT on eye-muscle control.

As Ayres (1972) noted:

> Normalizing postural mechanisms helps normalize extraocular muscle control. (p.85)

Adequate eye-muscle control is essential for fluent reading so that the eyes can follow lines of print. Also since reading is generally done with the reading material placed at the centre line of the body, crossing the midline difficulties may interfere with the reading process. The greater improvement of the OT group in the skills of copying from the blackboard tends to support this hypothesis since ability to focus the eyes is also essential for this task. Improvement in reading mediated by improvement in eye-muscle control would also explain the less noticeable effect on the children who were emergent at pretesting, since visual tracking skills are less central to learning at this stage than at the later reading stages.

Further support for this hypothesis is shown in the reading muscle analysis measure of the number of words omitted from the test by the reader. This measure is likely to reflect the adequacy of some aspects of eye-muscle control, since skipping entire lines of print results in a poor score. The OT group improved more on this measure than the other two groups did, although the differences between groups for all children weren't significant at .05 level.

Moreover, a number of children on the study were found to have serious eye-muscle difficulties and resultant visual-perceptual difficulties, following specialist assessment. Tests of visual accuity had not revealed these eye-muscle difficulties.

Eye-muscle control is also necessary for adequate performance on the Design Copy, Motor Accuracy and Handwriting

tests. In only MAC-Dom were there significant differences between groups, which seems to cast doubt on the eye-movement explanation for reading improvement. However, eye-movement is probably less central to performance of these tests than it is for reading performance.

Carter (1970) noted four eye-muscle problems which may affect learning: these included problems with accommodation, binocular-vision (failure of the eyes to attain and maintain exact simultaneous fixation, causing a single object to be seen as double), fixation movement (poor following of the eyes) and eye-muscle fatigue. The effect of eye-movement problems on learning have been recognised by some learning disability theorists: for example, Getman's (1968) six components for developing perceptual-motor skills include a programme of practice in eye-movements. This area has also been the focus of research. A study by Weber (1980), for example, found a significant relationship between deficient visual skills (fixation movements, binocular vision, and accommodation) and academic problems.

Visual perception. Visual perceptual disabilities likewise interfere with the reading process. An improvement in visual perceptual-skills as a result of the OT programme could also explain the reading results. These are distinguished from eye-muscle problems in that they involve inadequacies in the interpretation of information from the eyes (Hallahan and Kaufman (1976), although the two types of disorders overlap since a child with poor eye-muscle movement,(for example problems focusing on close-up material), is unlikely to have well-developed perception of form and symbols.

The relationship between learning difficulties and visual problems has been emphasised by a number of learning disabled practitioners (e.g. Frostig, 1967). This relationship has been more frequently examined in studies than the relationship between eye-muscle movement and reading. In fact, Hallahan and Cruickshank (1973) suggested that visual-perceptual training activities had become the most frequently occurring educational programme for l.d. children.

However, the results of both the Position in Space and Design Copy tests, which focus on visual-perceptual skills, show no significant differences between groups. Assuming that these two tests adequately represent tests of visual perceptual skills, this suggests that changes in visual perception in the OT group children, can not be responsible in any major way for their greater improvement in reading.

Concentration. A further factor which could have affected the OT group's reading scores is ability to attend. However, an improvement in concentration span should also have affected the other measures. This is, therefore, unlikely to be the principle reason for improvement in reading scores.

The PE group

The PE group also showed greater progress in reading than the control group. There is no way of determining whether this improvement was caused by similar or different factors to the improvement of the OT group. However, possible explanations for the improvement of the PE group in reading include a greater ability to attend or improved eye-muscle movement. Because of the nature of the activities involved

in the PE programme improved sensory integration and visual perception seem less likely explanations.

OT and PE programmes compared

Some difference between the OT and PE programmes was likely to be responsible for the greater improvement of the OT group in reading.

The first major difference between the programmes was the emphasis in the PE programme on the teaching of specific motor skills, compared to the OT's more developmental approach of integrating sensory input. The atmosphere of the two programmes also varied. Whereas the PE programme tended to have a serious "classroom-type" atmosphere, the OT programme had a more game-like, or fun approach. A third difference was in the size of the therapy groups which suggests that OT group children received more individual attention.

The interpretation of the findings on perceptual-motor variables has implications for the interpretation of the reading scores. If the effects of the OT programme on perceptual-motor variables are seen as reliably measured and therefore negligible, it can be argued that the significant effect of the OT programme on reading may be the results of Hawthorne effects, since Ayres' theory implies that improvement in reading development is mediated through improvement in sensory integration. This suggests that it is the fun and attention elements of the OT programme which caused the improvement, rather than the sensory integration per se.

However, the questionable reliability and validity of the SCSIT means it is premature to base interpretation of the reading findings on the perceptual-motor findings.

Moreover, the possibility that placebo factors contribute to the therapeutic benefit does not invalidate this therapeutic benefit.

Explanation of the Reading Results

The most likely mechanism for the apparent improvement in the OT and the PE groups' reading scores is a combination of the effects of improved eye-muscle control, sensory integration, and possibly concentration. Given the heterogeneous nature of this group it maybe that some children improved because of a greater ability to control their eye movements whilst the progress of others was affected by improved abilities at integrating information or concentration on the task at hand.

This suggests an explanation which combines the distinctive elements of the SIT programme with the suggested mechanisms of change and which accounts for the effect of the OT programme on children's reading. Two of the distinctive elements of the SIT programme, activities to enhance sensory integration and the one-to-one attention, are together suggested to influence children's eye-muscle control, sensory integration and ability to attend. The third element, the enjoyable nature of the programme is suggested to influence children's self-esteem which in turn may affect concentration span.

4.3 SUITABILITY OF CHILDREN FOR THE OT PROGRAMME

Present selection procedures

The differing degrees of perceptual-motor handicap and urgency amongst referrals are at present coped with by the OT programme at Christchurch Hospital in a number of ways, such as treating those rated as most urgent first, giving some subjects fewer treatment sessions and by altering the treatment aims and processes depending on other handicapping conditions concomitant with the perceptual-motor delay. However, almost all referrals are accepted. This research has implications for the OT programme's selection procedures.

The reasons for children being unsuited for therapy which were suggested in the results, are each examined.

Low DTS score and epilepsy

The DTS subtest involves simultaneously applying two tactile stimuli to either or both of the hands or cheeks of a child, who then identifies where he was touched.

There is considerable evidence to suggest that, with children, the number of DTS errors decrease with age (Fink and Bendon, 1953; Swanson, 1957) and as Ayres (1980) wrote:

> Few errors generally are made by children past their sixth birthday. (p.4.)

This suggests that a low DTS score from subjects older than six years should be interpreted differently to a similar score from younger subjects.

In the present study, subjects who evidenced very low scores (below 18) in the DTS at pretest, consistently showed very low scores at posttesting. Therefore a very low DTS score after six years of age, may be indicative of a stable, rather than

a developmentally related characteristic.

The SCSIT manual notes that a low DTS score may be evidence of disordered tactile system, emotional arousal at testing, or definite central nervous system pathology. Other authors also interpret low score in the test as a clinical sign for the presence of sensory dysfunction in patients with suspected organic pathology (Fink, Green and Bender, 1952; Swanson, 1957). Swanson, (1957) found that mental age was the most important variable in the determination of response to DTS.

This suggests that a low DTS score in children above six years reflects some kind of brain dysfunction or limitation in cognitive functioning. These subjects' failure to benefit equally from SIT may be explained in terms of Ayres' theory. Although SIT was developed for l.d. children who were assumed to have some minimal brain damage at the brain stem level, Ayres does not propose its use for brain damaged individuals, who can be assumed to have damage at other than the brainstem level.

Two of the children who had low DTS scores, also evidenced behavioural problems and one came from a socio-culturally deprived background.

Behavioural problems

This group of children tended to be non-compliant in treatment. They, and their families, had without exception received extensive help prior to pretesting from other agencies, and in particular those agencies involved with treating behavioural difficulties. Although a large proportion of l.d. children evidence behavioural problems or low self-esteem and it may be argued that SI problems

are a factor in the development of these children's disruptive behaviour, the subjects excluded on this criteria were distinguishable from other subjects by the severity of the behavioural disturbance. These children were more difficult to treat because they were often non-compliant in therapy.

Socio-cultural deprivation

This group of subjects (five) evidenced global developmental delay, including perceptual-motor delay. Their mothers were in some cases illiterate and tended to respond ineffectively when their children behaved disruptively. They also tended to have a high rate of contact with other treatment agencies. Two of these children also evidenced behavioural problems, and one had a low DTS score.

The effect of the OT programme on socio-culturally deprived children is difficult to determine, since the one child in the OT group who came from a socio-culturally deprived background, also evidenced behavioural problems. There were two children who were socio-culturally deprived but had neither low DTS scores or behavioural problems. They were both in the PE group and did not have severe SI problems. They both showed reasonable progress between pre and posttesting. This suggests either that such children can benefit from programmes other than OT programmes, or that they make adequate progress without treatment.

Research on subject selection

A number of authors have stressed the importance of adequate selection procedures for SIT (e.g. Bochner, 1980;

Myers and Hammill, 1976), but examination of previous research revealed no consistent guidelines for determining who should be selected for therapy. In the following section the suggestions of previous studies in response to this issue are compared with suggestions from the findings of the present study.

Two studies have specifically addressed the question of who is suited to therapy (Ayres, 1978; Jenkins and Sells, 1984). Ayres (1978) suggested that children with average or hyporeactive nystagmus benefit more than children with hyperreactive nystagmus. Jenkins and Sells (1984) on the other hand, suggested that SIT affected children who exhibited moderate, but not mild, motor delay. These two studies seem to come to quite different conclusions. In fact Ayres (1978) stated that children with hyporeactive nystagmus were "in the best condition physically" which tends to suggest that they were less, rather than more, motor-delayed. However, both these studies contained highly selected subject groups and it may be that their different conclusions reflect this. It seems, for example, that Ayres' subject group included a number of children with behavioural problems, but in the Jenkins and Sells' study, that non-compliance was a factor in the decision of who would be excluded. Unfortunately neither study is sufficiently clear about the selection process and characteristics of the final sample.

The conclusions of these two studies also differ from the conclusions of the present study. This is perhaps, again, explained by differences in the sample of children who received therapy. As well the Jenkins and Sells' and Ayres' studies were both seeking to determine which children

benefited most from therapy after they had already selected children they considered would benefit from therapy. Closer examination revealed certain consistencies about subject selection in these two studies.

Selection procedures. There is general consensus in the Jenkins and Sells' and Ayres' studies that not all children with learning problems or motor delay require SIT. Both studies made initial selection of subjects that were considerably different to the initial selection of subjects in the present study. The subjects in the Jenkins and Sells' study varied considerably in age range and handicapping conditions. The Jenkins and Sells' study and the present study were therefore comparable in these aspects of initial subject group. However, of the 112 referrals, the authors excluded 67, who on the basis of the Paediatric Screening (PS) instrument (Taylor et al, 1978), were considered not to be in need of treatment. Although it is not clear how the initial 112 children came to these investigators' notice, it is noteworthy that Jenkins and Sells exlcude 60% of their referrals before group assignment. This is in comparison to the present study in which only 10% of the total referrals were excluded. Out of a sample of 148 children, who were already selected as having learning disorders, Ayres (1972) also excluded 46 children from the SI programme. A similar selection was described in her 1978 study. Even taking into account the different initial samples of children, these figures suggest that some children who were included in the present study would have been excluded from an OT programme, if the criteria used by Jenkins and Sells, or Ayres had been followed.

Unfortunately, lack of explicit information results in the Ayres' study providing very few useful guidelines for selection. On the other hand, the PS, which was used by Jenkins and Sells, offers some suggestions for subject selection. Although Jenkins and Sells (1984) consider the PS to be an ineffective instrument for determining who should receive therapy, it was suggested in an earlier chapter that their criticisms appear unfounded.

The PS (Taylor et al, 1978) takes factors such as noncompliance, alternative treatment options and degree of motor delay into the assessment of need for therapy. These factors are similar to the factors found in the present study to predict poor progress. This suggests that the PS may be a useful tool for initial subject screening.

Relation of the results to the concept of learning disabilities

According to Ayres, it is the difficulties of learning disabled children, rather than, for example, developmentally delayed children, which are directly amenable to treatment with SIT. The definition of l.d. children generally excludes children whose problems can be attributed to environmental deprivation, emotional disturbance or mental retardation.

The results of the present study suggested that children who made the most progress were those who were neither socio-culturally deprived nor behaviourally disturbed nor had low DTS scores. These criteria correspond closely to the above criteria for learning disabilities. This implies that the children most suited to therapy were those who could be accurately labelled learning disabled and who, after examination of SCSIT scores and clinical observations were also considered to have SI problems.

However, without examining the progress of entire groups of children who have mental retardation or behavioural problems, or are socio-culturally deprived, it is not possible to conclude that these children do not benefit from treatment. It is only possible to note that, compared to learning disabled children, they tend to make less progress in therapy on some measures. This would be expected given their generally greater difficulties in learning.

Implications for the OT programme

The finding that the three subgroups of subjects who can be considered non-learning-disabled, made less progress in treatment, does not necessarily mean that they should be excluded from therapy. It does mean, however, that the needs of the different children referred to the OT programme should be carefully assessed.

In the case of the children with behavioural problems and socio-cultural deprivation it may be more appropriate for children and their families to firstly receive interventions, which are aimed at remediating these difficulties. Implications for the group of children with low DTS scores is less clearcut. Although Ayres designed SIT for a specific group of children with learning disorders, the OT programme at Christchurch Hospital is not solely SIT, but includes other procedures (e.g. those advocated by Bobath et al, 1976). Children with greater degrees of cognitive impairment may still have motor problems requiring treatment, but the aims and the processes of therapy need to take the greater degree of impairment into account. The treatment focus may need, for example, to be more on functional skills, such as learning

to dress oneself. Thus it may be appropriate for the children with low DTS scores to be referred to the OT programme not for sensory integrative therapy, but for other therapies to improve more functional motor skills. The perceptual-motor and learning measures used in this study were not designed to measure such progress.

4.4 LIMITATIONS AND RECOMMENDATIONS

Limitations of the Present Study

Although the present study sought to measure a variety of different areas of development which have not often been reported in evaluations of SIT, such as self-concept, perceptual-motor development and parents' and teachers' perceptions of their children's progress, a number of these measures proved to be unreliable. The measure of self-esteem yielded little useful information and, because of the lack of reliability of the majority of SCSIT subtests, perceptual-motor areas were not well examined in the present study. The measurement of children's development, therefore, was not as broad as was intended. This limited the conclusions which could be made from these results. It would have been preferable to have selected measures for which there was better evidence of reliability and to have included several measures of single areas of development.

A further limitation may have been the length of treatment for the children in the OT programme. These results suggested that improvement as a result of the programme was related to length of treatment. Although this is contrary to the findings of Jenkins and Sells (1984) it suggests that had the treatment programme lasted longer, then more differences may have been found between groups.

It would also have been preferable to have assessed all children on clinical observations prior to group assignment. This would have allowed the three children who were subsequently found to have insufficient SI problems to warrant therapy, to have been excluded before programmes were under way.

A further apparent limitation of the present study, subject involvement with other agencies and treatments, was a function of the "real world" nature of the study. Several subjects, for example, were involved with the SPELD programme, or experienced programmes similar to OT while they were attending the OT or PE programmes. Although children's attendance at SPELD and Ward 24 did not appear to affect the results, this feature of the subject group complicated an already complex analysis. However, an evaluation of an ongoing programme inevitably includes non-experimental factors which cannot be eliminated without including significant changes in the nature of the programme itself.

Consideration of the present level of understanding about the process of SIT, suggests that a further major limitation of this study was its design as a comparative evaluation. This is examined in the section which discusses recommendations.

Recommendations

Type of research. In the review of previous studies it was suggested that a general answer to the question of SIT's effectiveness was unlikely to be found because of the number of possible combinations of subjects, programmes and measures. All that could be provided were answers to very specific questions in which the particular subject group, programme and measures were all carefully specified.

The present study was designed as an evaluation of a specific OT programme rather than of SIT in general. The study's aim was therefore congruent with this position about

evaluation research. However, the type of design used on this study may not have been entirely appropriate to the existing levels of understanding about SIT.

Alternative types of evaluation designs have been suggested. Tuckman (1978), for example, discusses the difference between formative and summative evaluations. He stated:

> Formative evaluation refers to the internal evaluation of a programme, usually undertaken as part of the development process, in which the performance of students in a programme is compared to the objectives of the program. It is an attempt to debug learning material (or some other form of program) by trying them out on a test group as they are being developed....Summative evaluation....is an attempt to determine whether a fully developed programme is meeting its objectives more successfully than alternative programs (or no program). Summative evaluation uses the comparison process to evaluate a full-blown program while formative evaluation is part of the developmental process and thus precedes demonstration evaluation. (p.377)

The same distinction is made by Barbatsis (1978), who argues that comparative effectiveness studies are premature in areas of inquiry where most of the variables and models are not clearly identified. She suggests that this type of research limits the results to either the acceptance or the rejection of a pre-determined hypothesis. She advocates research which accepts the natural range of variables and seeks to identify those which are important to the research question. This type of research also attempts to identify principles and models linking the salient variables.

The replication of studies on the comparative effectiveness of SIT is unlikely to provide useful answers to important questions about what exactly happens for children in SIT.

Comparative effectiveness studies are probably primative in the area of SIT because of the present state of our understanding of the process of therapy. The research focus, therefore, needs to shift towards relating specific treatment variables with development and learning. The research designs used in comparable evaluation studies are probably not the research designs most suited to this changed focus.

Measures. The results of this study suggest that studies in the area of SIT need to measure a wide range of skills and areas of development. Measures of children's ability to attend, of self-esteem and of eye muscle control appear to be particularly important.

The results of this study also suggest the importance of selecting reliable measures. Of all the measure included in the present study, reading age was the most reliable. Reading age was also the only measure in which clearly significant results were found. The relative lack of reliability of the other measures may have been a factor in their failure to register significant treatment group effects. Where there is insufficient evidence supporting a test's reliability and validity with learning disabled children, studies may need to duplicate measures of some developmental areas.

These results suggest that the SCSIT, although capable of being usefully interpreted by a skilled therapist, do not have adequate reliability and validity for programme evaluation.

Conclusions

Three approaches were used to analyse the effect of treatment group on children's progress. Using these three approaches a significant effect of treatment group was found on two of the eleven reliable measures. The OT programme produced significantly better performance than the PE programme in both reading and fine motor skills and significantly better performance than no treatment in reading but not fine motor skills.

The comparison between the PE and the NT groups showed that the PE programme produced significantly better performance than the NT group in reading, whereas the NT group performed significantly better than the PE group in fine motor skills. No significant differences between group were shown on language, handwriting, self-esteem, gross motor skills or visual motor skills.

This suggests that the OT treatment was related to children's improvement in reading. However, because the comparisons between the OT and the NT group on fine motor development showed no significant differences between groups, it is not clear whether motor skills are improved through the programme.

The OT and the PE programmes varied in three important ways; that is content of programme, therapist to subject ratio and in "fun atmosphere". It is therefore not possible to determine which element was responsible for the superior gain in the reading age measure for the OT group subjects. However, it can be concluded that the small group physical education programme was not as effective as the individualized Occupational Therapy programme at Christchurch Hospital,

for remediating learning disabilities. The two programmes' effect on clumsiness is unclear.

The mechanism for the effect of the OT programme on reading is unknown. A possibility suggested by this study, but not fully investigated, was the effect of SIT on eye-muscle movement, whose efficient operation is important for reading. Improvement in eye-muscle movement, possibly with improvements in sensory integration, concentration span and self-esteem, combined to produce an improvement in reading ability.

An important finding of this study is that the OT referral list included a highly heterogeneous group of chilren, not all of whom were suited to SIT therapy. The subjects who benefited most from the OT programme were those who were clumsy but did not evidence other handicapping conditions, such as behavioural disturbance, socio-cultural deprivation or indication of neurological impairment.

This suggests the importance of thorough assessment procedures before referrals are accepted onto the OT programme. In the case of children whose predominant problems are behavioural or emotional, other treatment procedures may be considered a priority. In the case of those children who evidence signs of brain damage, the OT treatment needs to aim at more functional therapy goals and be carefully tailored to the different needs of these children.

These results also suggest the problems involved in effectively assessing response to therapy using the SCSIT. These tests, are not adequately reliable for ongoing programme evaluation.

The evaluations of SIT considered in total have shown only that the effectiveness of SIT programmes varies

considerably depending on the populations being studied, the exact content of the programmes, the ares of development assessed methods of measuring these areas.

Studies with more reliable measures and refined populations will simply add to this uninformative research, a point which has been made by a number of authors about forms of intervention as diverse as programmed learning and psychotherapy. Research which seeks information about specific relationships between variables in the process of therapy is needed before research that seeks to discover, in a general sense, whether SIT is effective. This absolute question can not yield a useful answer, because of the infinite combinations of treatment method, subject sample, and measures of development. SIT research needs to examine closely the process and the outcomes of change simultaneously.

REFERENCES

Alley, G. Perceptual-motor performances of mentally retarded children after systematic visual-perceptual training. American Journal of Mental Deficiency, 1968, 73, 247-250.

Alley, G. & Carr, D. Effects of systematic sensory-motor training on sensory-motor, visual perception and concept formation performance of mentally regarded children. Perceptual and Motor Skills, 1968, 27, 451-56.

American Psychiatric Association. Diagnostic and statistical manual of mental disorders, Third Edition, Washington, D.C., APA, 1980.

Ames, K. Sensory organisation and learning - it works. Academic Therapy, 1979, 4, 329-332.

Ayres, A.J. Sensory integration and learning disorders, Los Angeles Western Psychological Services, 1972.(a)

Ayres, A.J. Improving academic scores through sensory integration. Journal of Learning Disabilities, 1972, 5, 338-344.(b)

Ayres, A.J. Southern California Sensory Integrative Tests. Los Angeles; Western Psychological Services, 1972.(c)

Ayres, A.J. Southern California Postrotary Nystagmus Test Manual, Los Angeles: Western Psychological Services, 1975.

Ayres, A.J. Interpretation of Southern Californian Sensory Integrative Tests. Los Angeles: Western Psychological Services, 1976.

Ayres, A.J. Effect of sensory integrative therapy on the co-ordination of children with choreoathoid movements. The American Journal of Occupational Therapy, 1977, 31, 291-293.

Ayres, A.J. Learning disabilities and the vestibular system. Journal of Learning Disabilities, 1978, 11, 18-29.

Ayres, A.J. Southern California sensory integrative tests manual (Revised), Los Angeles: Western Psychological Services, 1980.

Bankson, N. Bankson language screening test. Baltimore: University Park Press, 1977.

Barbatsis, G. The nature of inquiry and analysis of theoretical progress in instructional television from 1950-1970. Review of Educational Research, 1978, 48, 399-414.

Barsch, R. Achieving perceptual-motor efficiency: A space-oriented approach to learning. Seattle: Special Child Publications, 1967.

Bassin, S.L. & Breihan, S.K. Relationship of performance on motor activities on reading achievement. Perceptual and Motor Skills, 1978, 46, 811-814.

Battle, J. A comparative study of the self-esteem of deviant and non-deviant students. Edmonton: Edmonton Public Schools, 1975.

Battle, J. A comparison of two self-report inventories. Psychological Reports, 1977, 41, 159-160.

Battle, J. Culture-free self-esteem interventories for children and adults. Seattle, Special Child Publications, 1981.

Battle, J. Self-esteem of students in regular and special classes. Psychological Reports, 1979, 42, 212-214.

Battle, J. A longitudinal comparative study of the self-esteem of regular and special education students. Edmonton. Edmonton Public Schools, 1980.

Blaxley, L., Clinker, M. & Warr-Leeper, G. Two language screening tests compared with developmental sentence scoring. Language Speech and Mearning Services in Schools, 1983, 14, 38-46

Bobath, K. & Bobath, R. Cerebral Palsy. In P. Pearson & C. Williams (Eds.). Physical Therapy Services in the Developmental Disabilities. Springfield, Illinois: C. Thomas, 1976.

Bochner, S. Ayres, sensory integration and learning disorders: A question of theory and practice. The Australian Journal of Mental Retardation, 1978, 5, 41-45.

Bochner, S. Sensory integration therapy and learning disabilities: A critique. Australian Occupational Therapy Journal, 1980, 2, 125-138.

Brennan, M. Brennan record for the interpretation of miscues, (Revised by Williams P.) Wagga Wagga NSW: Reading Language Centre, 1977.

Bruininks, R.M. The Bruininks - Oseretsky test of motor proficiency. Minnesota: American Guidance Service, 1978.

Bryan, T.M. Social relationships and verbal interactions of learning disabled children. Journal of Learning Disabilities, 1978, 11, 108-115.

Bullock, M.J. & Watter, P. A study in the effectiveness of physiotherapy in the management of young children with minimal cerebral dysfunction. Australian Journal of Physiotherapy, 1978, 24, 111-119.

Buros, O.K. The Eighth Mental Measurements Yearbook. New Jersey: Gryphon Press, 1978.

Carlsen, P.N. Comparisons of two occupational therapy approaches for treating the young cerebral palsied child. The American Journal of Occupational Therapy, 1975, 29, 267-272.

Carter, D.B. Interdisciplinary Approaches to Learning Disorders. A Symposium by Thirteen Contributors. Philadephia: Chilton, 1970.

Chalfant, I.C. & King, F.S. An approach to operationalizing the definition of learning disabilities. Journal of Learning Disabilities, 1976, 9, 228-243.

Clark, F., Miller, L., Thomas, J., Kucherway, D. & Azin, S. A comparison of operant and sensory integration methods on vocalisations and other developmental parameters in profoundly retarded adults. American Journal of Occupational Therapy, 1978, 32, 86-93.

Clay, M.M. Emergent reading behaviour. Unpublished doctoral dissertation, University of Auckland, 1966.

Clay, M.M. The early detection of reading difficulties: A diagnostic survey with recovery procedures. Auckland: Heinemann, 1979.

Coopersmith, S. The antecedents of self-esteem. San Francisco: Freeman, 1967.

Cratty, B.J. & Marlin, M. Perceptual-motor efficacy in children. Philadelphia, Lea & Febiger, 1969.

Cronbach, L.J. & Furby, K. How should we measure "change" or should we? Psych. Bulletin, 1970, 74, 68-80.

Culp, R., Packard, V. & Humphry, R. Sensorimotor versus cognitive perceptual training effects on the body concept of preschoolers. The American Journal of Occupational Therapy, 1980, 34, 259-262.

Delacato, L. Neurological organization and reading. Springfield Illinois: Charles Thomas, 1966.

De Pauw, K.P. Enhancing the sensory integration of aphasic students. Journal of Learning Disabilities, 1978, 11, 142-146.

Doman, R., Spitz, E., Zucman, E., Delacato, C. & Doman, G. Children with severe brain injuries: Neurological organizations in terms of mobility. Journal of the American Medical Associations, 1960, 174, 257-62.

Donaldson, L. & Maurice, P. South Auckland perceptual motor dysfunction survey. New Zealand Journal of Health, Physical Education and Recreation, 1984, 17, 4-7.

Edgar, C.L., Ball, T.S., McIntyre, R.B. and Shotwell, A.M. Effects of sensory-motor training on adaptive behaviour. American Journal of Mental Deficiency, 1969, 5, 713-720.

Elley, W.B. & Irving, J.C. Revised socio-economic index for New Zealand. New Zealand Journal of Educational Studies, 1976, 12, 154-160.

Fink, M. & Bender, M. Perception of simultaneous tactile stimuli in normal children. Neurology, 1953, 3, 27-34.

Frostig, M. Education of children with learning disabilities. In Frierson, E.C. & Barbe, W. (Eds.). Educating children with learning disabilities. New York: Appleton Century Crofts, 1967.

Getman, G., Kane, E., Halgren, C. & McKeen, G. Developing learning readiness. Manchester, Missouri: McGraw Hill, 1968.

Glass, G. A critique of experiments in the role of neurological organisations in reading performance. Unpublished paper. Urbana. University of Illinois College of Education, 1966.

Glass, G. and Stanley, J. Statistical Methods in Education and Psychology. Englewood Cliffs: Prentice Hall, 1970.

Goldstein, P.K., O'Brien, J.D. & Katz, G.M. A learning disability screening program in a public school. The American Journal of Occupational Therapy, 1981, 35, 451-455.

Goodman, L. & Hammill, D. The effectiveness of the Kephart-Getman activities in developing perceptual-motor and cognitive skills. Focus on Exceptional Children, 1973, 4, 1-9.

Goodman, Y. & Burke, C. Reading misuse inventory. Procedure for diagnosis and evaluation. London: Macmillan, 1972.

Green, C., Hope, M., Oates, R.K., Parry, T. & Procopis, P. Report to the Australian College of Paediatrics on Sensory Interactive Therapy, 1982.

Grimwood, L.M. & Rutherford, E.M. Sensory Integrative Therapy as an intervention procedure with Grade One "at risk" readers - a three year study. The Exceptional Child, 1980, 27, 52-61.

Hallahan, D.P. & Cruickshank, W. Psycho-educational foundations of learning disabilities. Englewood Cliffs, N.J.: Prentice-Hall, 1973.

Hallahan, D.P. & Kauffman, J.M. Introduction to learning disabilities. Englewood Cliffs, N.J.: Prentice-Hall, 1976.

Halliwell, J.W. & Solan, H.A. The effects of a supplement perceptual training program on reading achievement. Exceptional Children, 1972, 38, 613-621.

Hammill, D.D. & Larsen, S.C. The effectiveness of psycho-linguistic training: A reaffirmation of position. Exceptional Children, 402-414.

Hammill, D.D. & Weiderholt, J.L. Review of the Frostig Visual Perception test and the related training programme. In Mann, L. and Sabatino, D. (Eds.). The Review of Special Education. Pennsylvania: Butterwood Farms, 1973.

Harrell, F.E. and Kerry, L. Regression modelling strategies for improved pronostic prediction. Statistics in Medicine, 1984, 3, 143-152.

Harris, S. Effects of neurodevelopmental therapy on motor performance of infants with Downs' Syndrome. Developmental Medicine and Child Neurology, 1981, 23, 477-483.

Irving, J.C. & Elley, W.B. A socio-economic index for the female labour force in New Zealand. New Zealand Journal of Educational Studies, 1976, 12, 154-160.

Jenkins, J. & Sells, C. Physical and occupational therapy: effects related to treatment frequency and motor delay. Journal of Learning Disabilities, 1984, 17, 89-95.

Kealy, J. & McLeod, J. Learning disability and socio-economic status. Journal of Learning Disabilities, 1976, 9, 640-645.

Kephart, N. The slow learner in the classroom. Ohio:Merrill Books, 1960.

Keppel, G. Design and analysis. A researcher's handbook. (2nd Ed.). Englewood Cliffs: Prentice-Hall, 1982.

Kimball, J.G. The Southern California Sensory Integration Tests (Ayres) and the Bender Gestalt: a correlative study. The American Journal of Occupational Therapy, 1977, 31, 294-299.

King, L.J. A sensory-integrative approach to schzophrenia. The American Journal of Occupational Therapy, 1974, 28, 529-536.

Kirk, S.A. Illinois test of psycholinguistic abilities: its origins and implications. In J. Hellmuln (Ed.). Learning Disorders, Vol.3, Seattle, Special Child Publications, 1968.

Lamport, L.C. The effect of a specific perceptual-motor physical educational program on the self-concept of children with learning disabilities. Unpublished doctoral dissertation, University of New Mexico, 1974.

Larsen, S.C. The learning disabilities specialist: role and responsibilities. Journal of Learning Disabilities, 1976, 9, 498-508.

Larsen, S.C., Rogers, D. & Sowell, V. The use of selected perceptual tests in differentiating between normal and learning disabled children. Journal of Learning Disabilities, 1976, 9, 85-90.

Leonetti, R. A primary self-concept scale for Spanish-surnamed children, Grades K-4. Unpublished doctoral dissertation. New Mexico State University, New Mexico, 1973.

Lerer, R.J. An open letter to an occupational therapist. Journal of Learning Disabilities, 1981, 14, 3-4.

Lipton, E.D. A perceptual-motor development programme's effect on visual perception and reading readiness of first-grade children. Research Quarterly, 1970, 41, 402-405.

Logan, D.A. The effectiveness of a sensory-motor program with academically handicapped and normal first grade children. Unpublished doctoral dissertation. Texas Women's University, 1982.

McCormick, C., Schnobrich, J., Footlik S. & Poetker, B. Improvement in reading achievement through perceptual-motor training. Research Quarterly, 1968, 39, 627-633.

McKibbin, E.M. The effect of additional tactile stimulation in a perceptual-motor treatment program for school children. The American Journal of Occupational Therapy, 1973, 27, 191-197.

Magrun, W.M., McCue, S., Ottunbacher, K., Keefe, R. Effects of vestibular stimulation on spontaneous use of verbal language in developmentally delayed children. The American Journal of Occupational Therapy, 1981, 35, 101-104.

Maloney,M., Ball, T. & Edgar, C. Analysis of the generalizability of sensory motor training. American Journal of Mental Deficiency, 1970, 74, 458-469.

Miller, M. & Taylor, S. Perceptual and motor skills assessment for mentally handicapped adult psychiatric patients. A Pilot Study. (Unpublished).

Montgomery, P. & Richter, E. Effect of sensory integrative therapy on the neuromotor development of retarded children. Physical Therapy, 1977, 57, 799-806.

Morrison, D. & Pothier, P. Two different remedial motor training programs and the development of mentally retarded preschoolers. American Journal of Mental Deficiency, 1972, 77, 251-258.

Morrison, D. & Pothier, P. Effects of sensory-motor training on the language development of retarded preschoolers. American Journal of Orthopsychiatry, 1978, 48, 310-319.

Myers, P. & Hammill, D. Methods for learning disorders. New York: John Wiley & Sons Inc., 1976.

Neman, R. A reply to Zigler and Seitz. American Journal of Mental Deficiency, 1975, 79, 493-505.

Neman, R., Roos, P., McCann, B.M. Menolascino, I.J. & Heal, L.W. Experimental evaluation of sensorimotor patterning used with mentally retarded children. American Journal of Mental Deficiency, 1974, 79, 372-384.

New Zealand Department of Education. Physical Education - Standard 2 to Form 2. Wellington: Government Printer, 1978.

Nutthal, G.A.N. Which Methods of Teaching Should a Teacher Use? Unpublished Manuscript, University of Canterbury.

Ottenbacher, K. Sensory integration therapy: affect or effect. The American Journal of Occupational Therapy, 1982, 36, 571-578.

Ottenbacher, K., Short, M. & Watson, P. Nystagmus duration changes of learning disabled children during sensory integrative therapy. Perceptual Motor Skills, 1973, 48, 1159-1164.

Piaget, J. The mechanisms of perceptions. London: Routledge and Kegan Paul, 1969.

Platzer, W.S. Effect of perceptual motor training on gross - motor skill and self concept of young children. The American Journal of Occupational Therapy, 1976, 30, 423-428.

Rider, B.A. Perceptual-motor dysfunction in emotionally disturbed children. The American Journal of Occupational Therapy, 1973, 26, 316-320.

Riding, R.J. & Pugh, J.C. Iconic memory and reading performance in nine-year-old children. British Journal of Educational Psychology, 1977, 47, 132-137.

Ritchie, R. Personal communication, January, 1985.

Polatajko, H.J. The Southern California Postrotary Nystagmus Test. A validity study. Canadian Journal of Occupational Therapy, 1983, 50, 119-123.

Price, A. Nationally speaking. Sensory integration in occupational therapy. The American Journal of Occupational Therapy, 1977, 31, 287-289.

Reed, B.C. Review of the Southern California Sensory Integration In O.K. Buros (Ed.). The Eighth Mental Measurements Yearbook. New Jersey: Gryphon Press, 1978.

Roach, E. & Kephart, N. The Purdue Perceptual-Motor Survey. Ohio: Charles Merrill Publishing Co. 1066.

Robbins, M. & Glass G. The Doman-Delacato rationale: A critical analysis. In J. Hellmuth (Ed.). Educational Therapy (Vol.II), Seattle: Special Child Publications, 1969.

Rood, M. The use of sensory receptors to activate, facilitate and inhibit motor response, autronomic and somatic in developmental sequence. In C. Sattley (Ed.). Approaches to the treatment of patients with neuromuscular dysfunction. Dubuque, Iowa: Brown, 1962.

Ross, A. Psychological aspects of L.D. and reading disorders. New York: McGraw Hill, 1976.

Schroeder, R. Improvement in academic achievement through enhancement of perceptual and sensory integrative functioning. School Psychology International, 1982, 3, 97-104.

Sieben, R.L. Controversial medical treatments of learning disabilities. Academic Therapy, 1977, 13, 133-147.

Silberzahn, M. Sensory integrative function in a child guidance clinic population. American Journal of Occupational Therapy, 1975, 29, 29-34.

Slingerland, B.M. Slingerland Screening Tests for Identifying children with specific language disability. Massachussetts: Education Publishing Service, 1970.

Strauss, A. & Werner, H. Disorders of conceptual thinking in the brain injured child. Journal of Nervous and Mental Disease, 1942, 96, 153-72.

Sullivan, J. The effects of Kephart's perceptual motor-training on a reading clinic sample. Journal of Learning Disabilities, 1972, 5, 545-551.

Swanson, R. Percpetion of Simultaneous Tactile Stimulation in Defective and Normal Children. American Journal of Mental Deficiency, 1957, 61, 743-752.

Taylor, D., Christopher, M., and Freshman, S. Pediatric Screening: A tool for occupational and physical therapists. Seattle: University of Washington Health Sciences Learning Resource Centre, 1978.

Tarnopol, L. Introduction to neurogenic learning disorders. In Tarnopol, L. (Ed.). Learning disorders in children. Boston: Little Brown & Co. 1971.

Tuckman, B.W. Conducting Educational Research (2nd ed). New York: Harcourt Brace Jovanovich, 1978.

Weber, G.Y. Visual Disabilities - Their Identification and Relationship with Academic Achievement. Journal of Learning Disabilities, 1980, 13, 13-19.

Westman, A.S. Review of Southern California Sensory Integrative Tests. In O.K. Buros (Ed.). The Eighth Mental Measurements Yearbook, New Jersey: Gryphon Press, 1978.

White, M. A first grade intervention program for children at risk for reading failure. Journal of Learning Disabilities, 1979, 12, 231-237.

Wong, B. The role of theory in learning disabilities research. Journal of Learning Disabilities, 1979, 12, 585-595.

Vellutino, F.R., Steiger, B.M., Moyer, S.C., Harding, C.J. & Nites, J.A. Has the perceptual deficit hypothesis led us astray? Journal of Learning Disabilities, 1977, 10, 325-343.

Yanagida, E. et al. A district screening programme for identifying speech-language problems. Report Hawaii Foundation Programme, 1982.

Zigler, E. & Seitz, V. On "An experimental evaluation of sensorimotor patterning": A critique. American Journal of Mental Deficiency, 1975, 79, 483-492.

Ziviani, J., Poulsen, A. & O'Brien, A. Effect of a sensory integrative/neurodevelopmental programme on motor and academic performance of children with learning disabilities. Australian Occupational Therapy Journal, 1982, 29, 27-33.

APPENDIX I

Table A. Number of Positive, Mixed or Negative Results Relative to the Four Types of Criterion Measures Reported in Studies which evaluated SIT

Type of Criterion Measure	Results: Positive +	Mixed +0	No Difference 0	Total
Academic	1	3	2	6
Language	2	0	2	4
Motor and Sensory Integrator	8	2	4	14
Personal/Social Body Concept	1	0	1	2
Total percentage	46%	19%	35%	100%

Appendix II

Table B Mean Squares of Treatment, Pretest, Age and Error Variance

Variable	Mean Square			
	Treatment	Pretest	Age	Error
Handwriting	0.04	3.56	0.00	0.09
Reading Age	0.30	123.99	0.12	0.24
Reading Word Test	31.25	209.98	23.67	13.49
BLST	172.02	15,473.80	419.55	66.12
Teacher and Parent Problem Total	6.97	69.59	0.25	4.82
SCSIT				
P.S.	1.56	171.50	36.89	8.45
D.C.	2.41	516.49	6.20	6.92
G.R.A.	19.42	199.72	11.79	12.94
I.P.	0.06	125.94	54.26	10.07
MACR	56.89	2229.98	55.51	41.93
MACL	4.73	2358.95	44.37	106.16
MAC-Dom	92.87	1530.07	133.75	39.58
MAC-NDom	17.15	2459.35	23.28	29.15
S.V.	14.06	181.70	160.37	22.91
F.G.	5.69	74.38	95.49	10.98
KIN	15.00	80.72	927.36	118.75
M.F.P.	5.13	25.37	5.28	3.72
F.I.	9.50	12.71	106.40	6.34
L.T.S.	1.19	360.25	399.35	38.89
D.T.S.	1.20	238.63	19.42	11.55
B.M.C.	0.06	125.94	54.26	10.07
S.B.O.	1515.86	27,078.93	2,952.81	1,687.81
S.B.C.	118.36	71.91	173.39	62.46
OML	29.18	71.34	258.08	29.01
OMLX	10.05	275.80	111.16	31.05
R.L.O.	8.67	37.53	99.80	26.85
Self Esteem	32.30	49.36	109.48	47.36
Reading Letter Test	19.87	2056.11	419.56	67.60
Teacher Ratings	6.77	319.82	8.16	10.46

Appendix II (Continued)

Table C Areas of Sensory Integrative Dysfunction

Identity Number	Group	Sensory Integrative Dysfunction 1	2	3	Other
01	PE	2	4	3	19
04	OT	0	5	2	39
05	OT	5	9	4	
06	PE	4	2	5	3917
07	OT	5	3	9	4
09	OT	1	5	3	279
11	PE	4	1	2	57
12	OT	5	2	3	9
13	PE	5	2	9	743
14	NT	4	2	1	9753
16	PE	3	5	1	29
17	PE	5	7	0	92
18	OT	7	5	0	
20	OT	1	2	5	
23	OT	7	1	8	
24	OT	1	3	2	5
25	PE	2	7	5	4
26	OT	4	5	1	23
27	NT	3	2	4	9
29	PE	5	2	0	74
31	OT	5	2	3	9
32	NT	3	5	2	19
33	OT	5	3	7	12
34	PE	2	5	1	379
35	PE	5	2	1	379
36	NT	5	3	2	19
37	OT	2	5	3	
38	OT	0	5	1	237
39	NT	2	0	4	5739
41	PE	4	2	3	597
42	OT	1	5	0	7
43	NT	3	2	5	7
44	NT	8	2	5	31
45	PE	2	7	3	9
46	NT	5	2	1	39
47	PE	1	7	2	345
48	NT	7	4	5	23
49	NT	7	2	4	
50	PE	7	2	5	193
52	NT	4	7	5	29
53	NT	5	2	9	37
55	NT	1	3	5	
56	NT	2	3	5	197
57	NT	5	4	9	
58	OT	1	5	2	9
59	NT	4	2	1	
60	NT	5	2	7	139
61	NT	2	4	7	39
62	OT	2	5	1	79
63	NT	1	2	5	379
64	NT	1	7	2	4
65	OT	0	7	5	2319
66	OT	0	1	2	35
67	NT	0	5	2	3

Table C (Continued)

Note:

0	behavioural problem
1	vestibular dysfunction (includes muscle tone equilibrium and protective extension problems)
2	somatosensory dysfunction (disorders of tactile system)
3	form and space problems and visual problems (includes visual perception, eye muscle, and visual acuity problems).
4	dispraxia (problems with motor planning)
5	motor control problems
7	lateralisation difficulties
8	left and right hemisphere dysfunction
9	problems with primitive reflexes.

APPENDIX III

SENSORIMOTOR INTEGRATION THERAPY RESEARCH PROGRAMME

QUESTIONNAIRE FOR TEACHERS

Please note that your answers to these questions will be kept strictly confidential to the researcher. No record will be kept of your name or your school's name once your replies are coded.

Child's Name: _____

Class Level: _____

Teacher's Name: _____

Room Number: _____ Date: _____

A. GENERAL

1. Please write a brief (2 or 3-sentence) description of the child including abilities, behaviour in the classroom or any other significant characteristics.

_____

_____

_____

_____

_____

2. What, if any, do you consider to be this child's main problems?

_____

_____

_____

_____

_____

3. What other problems does s/he have?

_____

_____

_____

_____

_____

4. Do you know if this child has received any special help for reading, speech, behavioural adjustment or any other problem areas? Please indicate type of help and approximate dates.

B. SUBJECT AREAS

Please rate the child's abilities, compared with other children of her/his age, on the five-point scales provided, by drawing a circle round the appropriate rating.

		Excellent	Good	Average	Poor	Very p
5.	Reading	1	2	3	4	5
6.	Spelling	1	2	3	4	5
7.	Handwriting	1	2	3	4	5
8.	Mathematics	1	2	3	4	5
9.	Physical education and sport	1	2	3	4	5
10.	Written language (ability to put ideas in a written form)	1	2	3	4	5
11.	Speech (ability to clearly express ideas orally)	1	2	3	4	5

Excellent Good Average Poor Very p

12. List any subject areas, or school activities, for which you consider this child now needs extra help.

C. CLASSROOM BEHAVIOUR

The following are several descriptions of children's behaviour. Please indicate the extent to which each description is characteristic of this child by ticking the appropriate response on the right.

		Never Occurs	Rarely Occurs	Often Occurs	Very Freque
13.	S/he is aggressive and hits other children.	☐	☐	☐	☐
14.	S/he is submissive and overly cooperative	☐	☐	☐	☐
15.	S/he is confident and self-assured	☐	☐	☐	☐
16.	S/he is withdrawn and does not contribute much	☐	☐	☐	☐
17.	S/he gets on well with other children	☐	☐	☐	☐
18.	S/he is attention-seeking	☐	☐	☐	☐
19.	S/he is restless and moves around a lot in the classroom	☐	☐	☐	☐
20.	S/he has a short attention span and does not stay at one activity for long	☐	☐	☐	☐
21.	S/he finds it hard to copy accurately from the blackboard	☐	☐	☐	☐

22. Name any of this child's behaviours which you feel you would most like to se improved.

_____

_____

_____

_____

_____

_____

23. How would you estimate this child's potential ability (their comprehension and intelligence) aside from any learning difficulties?

24. Are there any additional comments that you think would be useful in understanding this child's behaviour and personality?

THANK YOU FOR TAKING THE TIME AND TROUBLE

TO FILL IN THIS QUESTIONNAIRE.

OCCUPATIONAL THERAPY RESEARCH PROGRAMME

Questions for Parents

Child's name: _____

Date: _____

Are you this child's father? mother? other? (circle one)

These questions are to help us find out what your child most needs help with. We have found that things that parents notice can be very helpful for our work with a child.

---

1. What do you think is your child's main problem?

2. Could you give an example of this problem? When did it happen?

3. What subjects or activities cause your child the most problems at school?

4. Are there subjects at school you think your child needs extra help with? Which ones?

5. Are you worried by your child's speech? If you are, could you describe the problems.

6. Are you worried about the way your child gets on with other children? If you are, could you describe the problems.

These are a list of sentences about children. Read each sentence and put a tick in the box that describes your child.

		True	Not true	Not sure
7.	He/she has difficulty with games or sport.	☐	☐	☐
8.	He/she seems to be clumsy and bumps into things a lot.	☐	☐	☐
9.	He/she is often fighting, or rough with other children.	☐	☐	☐
10.	He/she likes to run around a lot.	☐	☐	☐
11.	He/she is a very quiet child.	☐	☐	☐
12.	He/she sleeps well at night.	☐	☐	☐
13.	He/she is scared to try new things.	☐	☐	☐
14.	He/she likes to have a lot of attention.	☐	☐	☐
15.	He/she does not often play at one game for long.	☐	☐	☐
16.	He/she can look after him/herself (dresses self etc.)	☐	☐	☐

17. What good things has the programme done for your child?

18. What bad things has the programme done for your child?

19. What parts of the programme do you think really helped your child?

20. Did you receive a programme of activities to do with your child at home? If yes, did you use it (tick one)

- A lot (10 or more times) ☐
- Quite a lot (between 4 and 10 times) ☐
- Occasionally (1 to 3 times) ☐
- Not at all ☐

21. Do you think the programme as a whole has been (tick one)

A lot of help	☐
A little help	☐
No help	☐

22. Are there any ways you think the programme as a whole could be improved, or comments you would like to make?

APPENDIX IV

WRITING ANALYSIS RECORD

		Feb.		Oct.	
Total Number of Letters and Residuals					
Type of Error		Tally	Total	Tally	Total
Position in space (1.5mm)	1a				
Spacing between words (less than 1 letter, greater than 4 letters)	b				
Words repeated/omitted/order muddled	c				
SUBTOTAL					
Mirror image or reversals (b for d, on for no, etc.)	2a				
Lower case instead of capitals and reverse	b				
Insertions or omissions of letters (eg palay)	c				
Transpositions (letters out of sequence, eg gril)	d				
Substititions (eg sand for said)	e				
Inversions (eg n for u, f for t, b for p)	f				
Repetition of letters	g				
SUBTOTAL					
Residual letter (unrecognizable letter shape)	3a				
Letter size (3mm greater or less than predominant size)	b				
Wobble (do not count single aberration)	c				
Incompleteness and lack of closure (eg A without the crossbar)(1mm	d				
Letter misformed as result of error in direction	e				
Additions to the letter shape or copying over (1mm)	f				
Other letter formation errors not noted elsewhere					
SUBTOTAL					
TOTAL					

Time if completed _____

APPENDIX V

Abbreviated forms of Southern California Sensory Integrative Tests (SCSIT, Ayres, 1972c)

Tests	Abbreviated Form
Visual Perception	
Space Visualization	SV
Figure-Ground Perception	FG
Position in Space	PS
Design Copying	DC
Somatosensory Perception	
Kinesthesia	KIN
Manual Form Perception	MFP
Finger Identification	FI
Graphesthesia	GRA
Localization of Tactile Stimuli	LTS
Double Tactile Stimuli Perception	DTS
Motor Performance	
Imitation of Postures	IP
Bilateral Motor Coordination	BMC
Standing Balance: Eyes Open	SBO
Standing Balance: Eyes Closed	SBC
Motor Accuracy: Right	MAC-R
Motor Accuracy: Left	MAC-L
Motor Accuracy: Dominant[a]	MAC-Dom
Motor Accuracy: Non-Dominant[a]	MAC-NDom
Other	
Crossing Midline of Body	CML
CML: Crossed Items Only	CMLX
Right-Left Discrimination	RLD
Postrotary Nystagmus	PRN

[a] These forms occur only in the present study

Appendix VI

Table D Reading Age Scale

Scale	Reading Age or Skill Level
5.0	Emergent - unable to read beginning readers (Ready to Read series)
5.3	Reading beginning readers, but unable to read extract at 5-5½ year level.
5.5	5-5½ Able to read 5-5½ year extract
6.0	5½-6
6.5	6-6½
7.0	6½-7
7.5	7½-7½
8.0	7½-8
8.5	8-8½
9.0	8½-9
10.0	9-10
11.0	10-11
12.0	11-12
13.0	12-13
14.0	13-14

Appendix VI (Continued)

Reading Miscue Analysis Sheet

Tick Y or N columns for each column of questions

B.R.I.M.

		Meaning Maintained		Corrected		Semantic		Syntactic		Graphic		Phonic	
Text	Reader	Y	N	Y	N	Y	N	Y	N	Y	N	Y	N

Appendix VII

Occupational Therapy Department
Christchurch Hospital

July 1984
M. Chester NZROT

HOME PROGRAMME FOR

GAMES TO IMPROVE GROSS COORDINATION OF BODY MOVEMENTS

1. Swinging - loves to swing and spin himself. Is there a tree which an old tyre or old rolling pin can be hung from?

   Use swings and slides at any public playground.

2. Jumping - Elastic skipping:

   (a) jump from 1 side of elastic to the other, landing on the elastic;

   (b) twist elastic around feet, jump up and land with 2 feet in the middle of elastic;

   (c) make up own sequences of jumps, twists and turns.

   - Rope skipping;

   (a) lie rope flat on floor and jump across it with feet together;

   (b) swing rope over own head and jump over it when it lands on the floor;

   (c) have 2 people turning the rope as you jump over it.

   - Jumping down and up stairs

3. Wheel-barrow walking on hands

4. Push of War - 2 people stand either side of a line and hold the ends of an old towel, rope or something. Then try to pull the other person over the line.

5. "Twister" - this game is available commercially at Whitcoulls for about $12 or $13. It helps improve coordination, and left/right discrimination, and can be a lot of fun.

6. Ball games (a) 2-square, hitting the ball with 2 hands together, or 1 hand;

   (b) hit a swinging ball (available ready-made at toy shops, about $4) with 2 hands together (as with a rolling pin or baseball bat); or hit with alternate hands;

(c) kick swinging ball:
(i) stand and kick with 1 leg;
(ii) lie on back and kick with 2 legs;

(d) throw balls at a target.

7. Any other game you and the boys can think up which uses his whole body in large movements.

GAMES TO IMPROVE FINE COORDINATION

1. Table games (a) O's + X's especially if has to draw up the game each time;

(b) any game in which counters are used (connect 4, snakes and ladders, draughts, mastermind, pick-up-sticks etc.)

(c) jigsaw puzzles of a subject which interests him;

(d) marbles;

(e) darts;

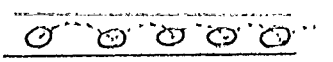
(f) meccano sets where pieces are screwed together to make shapes and gadgets.

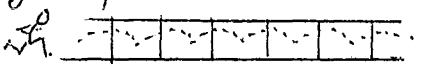
2. Drawing and colouring-in-books - especially those which have a variety of tasks such as joining the dots, colouring in the pictures, finding hidden articles etc.

3. Drums - if you can stand the noise!

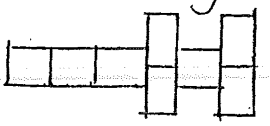
4. Finger games - such as "here is the church, here is the steeple, open the door, and here are the people."

PATHS

1. Chalk circles, a stride apart,  and run putting alternate feet in each circle.

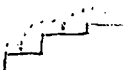
2. Or, using the same technique, jump over horizontal marks one foot in each space. 

3. Hopscotch pattern using chalk — or painted permanently. and played with a block of wo



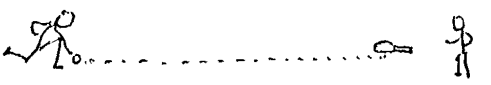
4. The same pattern can be used for "Pavement Ball", where y "lob" a ball into each successive square and catch it on the first bounce.

5. "Standing broad jump." Stand with both feet behind a chalked line and jump with both feet to land with the heels past the next line.

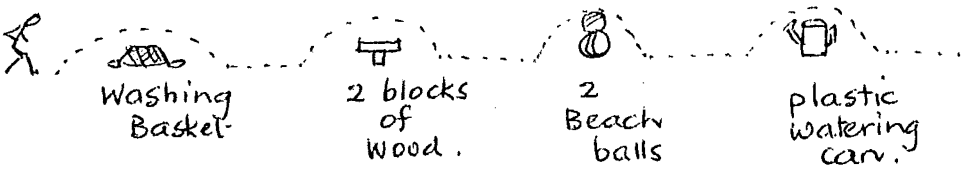
6. Jumping up and down the back steps 

LAWN

1. "Hit and Roll" ..... a game that can be played with two or more. A bit like French cricket, only when the ball is fielded the batter places the bat down on the ground and the fielder rolls the ball to try to hit the bat.



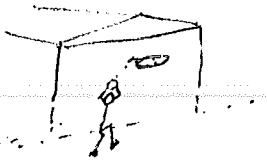
2. "Jump the Obstacles" or "hurdles"

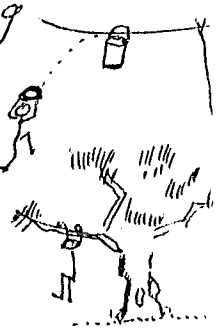


3. Handstand practice  or  or  against a wall.

4. Aiming practice (i) at a 4 gallon tin 

(ii) Into the clothes basket 

(iii) Into a ring fastened to a wall or tree. 

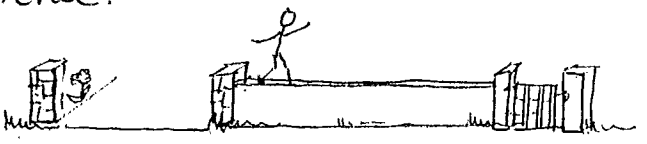
(iv) Into a bucket hanging on a clothes line. 

(v) Using wooden bats and shuttlecock two can play across a rigged up net. 

5. Arm and shoulder strength activities (i) Swinging on a tree

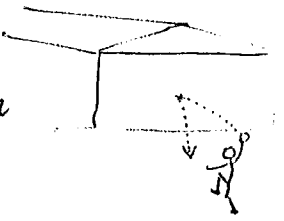
(ii) If no tree, a tubular pipe 

(iii) A rope suspended from a tree or from rafters of the garage 

6. Walking along a fence. 

- forwards
- backwards
- sideways

WALLS

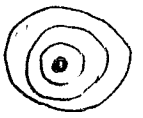


1. Throw against a wall "tennis ball" and catch
or "larger ball"

2. Play "sevens", i.e. every sequence to be done seven times before you move on to the next.
e.g. catch on the bounce
catch on the full.
clap and catch
turn round and catch
etc.

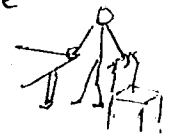
3. Use a wooden or plastic padder bat with which to aim the ball against a wall. 

If there are two players, each can hit alternately.
(as in squash)

4. Paint a target on the wall.  or 
and try to get a bull's-eye.

INDOORS

1. Straight arm support on chairs 
(i) swinging 

(ii) using one chair and the corner of the table. 

2. Forward roll on the carpet.

3. Line jumps over a join in the lino or carpet.

Appendix VII (Continued

OCCUPATIONAL THERAPY DEPARTMENT

CHRISTCHURCH HOSPITAL

TREATMENT RECORD.

CHILDS NAME_____ THERAPIST_____ DATE_____

Intended order in Session	Major Equipment (by No.)	Other Equipment (by No.)	Other Information (body posture, activity etc.)	Purpose of Activity	Activity occurred (tick)	Comments

1. Anti - A.T.N.R. postures.
2. Balance Equipment
3. Barrel
4. Beads
5. Big ball
6. Big roll
7. Bilateral cups
8. Cable reel
9. Cardboard box
10. Drawing
11. Generalised Somatosensory stimulation.
12. Hula Hoop
13. Magnetic fish
14. Make believe play
15. Moon Hopper
16. Pillow fights
17. Playing cards
18. Quoits/skittles
19. Ramp
20. Sandbags
21. Scooterboard
22. Shock rope
23. Skipping rope
24. Small ball.
25. Small tables
26. Space shuttle
27. Spec. fine hand co-ordination tasks.
28. Spec. Somatosensory stimulation
29. Spec. visual-perceptual tasks.
30. Swing
31. Swing ball
32. Table games
33. Tin can stilts
34. T-stool
35. Tyre
36. Weights.

Appendix VII (Continued)

THE PHYSICAL EDUCATION SECTION

N.C.H.B. RESEARCH PROPOSAL

Aims:

.. To provide a balanced Physical Education programme that will satisfy the needs of the children selected for this experiment, and which will fall within the criteria as set out by the organising committee.

.. To structure the programme in such a way that the fitness component of physical education is emphasised.

.. To make the lessons enjoyable and stimulating mentally and physically and to allow opportunity for normal social interaction to occur amongst the children.

.. To try to ensure that the activities chosen will allow the children to experience success, either in what they already know, or by introducing new skills appropriate to their growth and development.

.. To ensure that the activities selected allow the children to work at their own level and at their own rate.

.. To help children achieve a standard of performance conimensurate with that expected from children at that age.

.. To establish a check list of motor skills to provide some guidelines as to progress over this period.

Content

1. The "Fitness" component -

   - exercises to work the body joints, e.g. head, neck, shoulder, hip, knee, ankle

   - to strengthen the muscles, e.g. shoulder, arms, back, chest, legs.

   - exercises and activities to improve lung capacity

   - activities to improve motor co-ordination.

   All these can be performed slowly at first while the children learn what their function is. The tempo can be increased until the exercise is non-stop, providing a good standard of performance is maintained.

2. Other warm up activities can be based on "locomotor" (movements (walk, run, gallop, jump etc.) or "non-locomotor" movements (push, stretch, bend, etc.) used separately or in combination.

   applying factors of ...tempo
   ...direction
   ...level
   ...range
   ...focus
   ...energy
   ...stillness

3. Fun exercises, ...in pairs or threes
   ...using formations (circle)
   ...space factors

Methods to be used

1. Lesson plans to be recorded. These plans to be based on the Department of Education texts, (Junior 5-7+, Senior 8-11 years), flexible enough to allow for changes if the need arises.

2. The lesson plans to be structured to incorporate

   ... work load (or warm-up activities)

   ... skill load (teaching, practice and application)

   ... final section (relaxation exercises, discussion etc.)

3. The lessons to include variation in pupil management (individual, pair, team).

4. Apparatus that through use can help children become more skilful, or better understand the way their body works, e.g. floor, walls, bench, small balls, large balls, bats, ropes, hoops, skittles, mats.

5. Background music to enhance body movement, e.g. fitness exercises, dance, gymnastics.

6. Incentive charts or cards for children.

Skill Type Activities

Junior	Senior
Balls: roll, bounce, throw catch, kick, hit, dribble	Balls: used for accuracy, distance
: used with other equipment, e.g. on, through, across, over, under, along etc.	: hitting, batting, throwing, catching, fielding, passing
	: used with equipment

Agilities

: Rolling in a wide variety of ways -

: Supporting weight on arms (hanging and inverted)

: Walk run jump hop etc. and LAND efficiently (hoops and ropes)

: Moving with balance and control

: Early progression of skipping skill...ropes.

Agilities

: Rolling with control

: Extensions - forward, backward, shoulder

: Flow from one activity to another

: Move with poise and grace - co-ordinated movement

: Combinations of movement

: Forward and backward skipping - ropes

Work individually or in pairs.

Dance

: Respond to rhythms (music, poems, words. songs)

: Communicate through movement

: Perform simple folk dance

Athletics - Nil

Dance

: Respond to rhythms

: Show greater competence in communicating through movement

: Perform more complex folk dances

Athletics

: Run with economy of effort

: Jump for height, distance, throw for distance

Games

: Imaginative games - e.g. What's the time Mr. Wolf? The Sea and her children

: Skill games, e.g. Keep the basket full
City gates

Games

: Skill games, e.g.
Chinese wall
Four square
Wandering Ball
Stop ball rounders
Relays